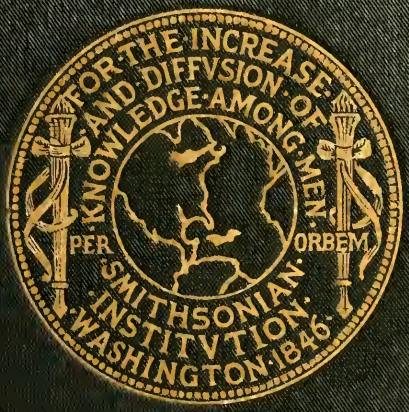
FOR·THE·INCREASE·
AND·DIFFVSION·OF·
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SMITHSONIAN INSTITUTION

UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

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The present volume is the sixty-eighth of this series.

The *Bulletin*, the first of which was issued in 1875, consists of a series of separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogues of type-specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *January 15, 1927.*

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[1] Date of publication.

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[1] Date of publication.

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By H. E. Ewing

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TERTIARY INSECTS FROM ARGENTINA

By T. D. A. Cockerell
Of the University of Colorado, Boulder

Until recently no fossil insects were known from South America. The first to be recorded were two Diptera in amber from Colombia, unfortunately of uncertain age.[1] As early as 1917 Dr. G. R. Wieland found two species in Upper Triassic (Rhaetic) rock at Minas de Petroleo, southwest of Mendoza, Argentina. These he described and figured in a recent paper[2] regarding them as new genera and species of Tipulidae (Diptera). The smaller species is Dipterous but the large one (*Tipuloidea rhaetica*) is in fact one of the Homoptera, with the clavus missing, as is so often the case in fossils. In any case, however, Doctor Wieland's discovery is of extraordinary interest, and his well-illustrated account will remain one of the most important contributions to palaeoentomology. We now have to chronicle a third find of South American fossil insects, made by G. L. Harrington, of Buenos Aires. The material was kindly forwarded to me by Dr. R. S. Bassler and belongs to the United States National Museum. The locality is Sunchal in the Province of Jujuy, apparently more than 500 miles north of Doctor Wieland's locality. The rock is gray, and is known to be of Tertiary age. In appearance and in the absence of compression of the specimens it is just like the Oligocene insect-bearing rock at Gurnet Bay, Isle of Wight.[3]

Fragments of numerous insects are present, but I have felt obliged to restrict myself to the description of seven species of beetles (from elytra) and one caddis-fly (from a wing). There can be no doubt that extensive collecting would greatly increase the list of recognizable species, and would presumably reveal forms of greater interest and significance. The assemblage now recorded is unsatisfactory, yet important as giving us a first idea of the Tertiary insect life of the region. I should not venture to name the beetle elytra but for

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3. Large and black, width 3 mm., punctures very strong ..... Otiorhynchites aterrimus
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More robust, width over 2 mm 5
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Apical region narrowed, apex narrower ..... Anthonomus (?) sunchalensis

It will be seen that six of the seven described species are considered to be weevils.

TRICHOPTERA

The small specimen described below appears to represent a family (Molannidae) new to South America, but it is so imperfect that its generic position remains in doubt.

MOLANNA (?) DEROSA, new species

Anterior wing; length as preserved 4 mm., probable total length 5 mm.; shape of wing about as usual in the genus; as preserved it is colorless, with the venation pale brown. It is not possible to see all the details, but most of what is visible agrees quite closely with the male of the European *M. angustata* Curtis. The apparently reduced and simple condition of the radius, the only moderately oblique end of the cell between the radius and its sector, the r.-m. cross-vein only just beyond the end of the radial cell, and the media with two straight branches above, reaching edge of wing above the apex, are all *Molanna* characters. Below this it is only possible to see part of an apparently simple vein, then a fork and then part of another simple vein. In principle this is not very different from the condition in some species of *Molannodes*. In view of the imperfection of the specimen and the extreme differences in venation known to exist in this group, especially when the living and amber (Oligocene) species are compared, there is no basis for proposing a new generic name.

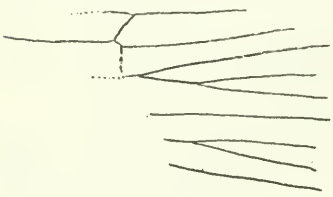

FIG. 1.—MOLANNA DEROSA. ANTERIOR WING

Sunchal, Dept. Sta. Barbara, Prov. Jujuy, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70809, U.S.N.M.

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Plate 1, fig. 1

Elytron 5 mm. long and 3 wide; 4 to 5 punctures in 1 mm. of length. Black, convex, with eight broad longitudinal grooves containing large round punctures, which are larger than the intervals between them; there are about or rather over 20 punctures in the middle grooves; in addition to the above, along the lower margin is a row of close-set small punctures, the upper part of which is divided into two widely separated rows; apex of elytron obtuse.

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In the same piece of rock as the type of *Molanna derosa*, and only 5 mm. from it. This may not be a true *Cossonus*, but it is more convincing than the two fossil species recorded by Scudder from North America so far as the shape of the elytron goes. *C. (?) devoratus* might be referred to such a Chrysomelid genus as *Anisodera* or *Anisoderopsis* but it is easily separated by the punctures not being in geminate rows.

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Elytron dark reddish brown; length 5 mm., breadth 2.4 mm.; outer (upper) margin gently convex, apex obtusely angled. Nine fine punctate striae, the punctures small and somewhat elongate, over 30 in each stria; distance between successive punctures about half the distance between striae; the striae converge apically, the innermost meeting some distance before the apex. A delicate linear groove runs parallel with and close to the margin.

Sunchal, Dept. Sta. Barbara, Prov. Jujuy, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70812, U.S.N.M.

The arrangement of the striae suggests *Anthonomus*, but of course whatever scales (or pubescence) may have existed have been lost. The type is on the same piece of rock as *Cossonus devoratus*, and less than 2 mm. from it. Other elytra of *A. (?) sunchalensis* are on the same rock.

CURCULIONITES HARRINGTONI, new species

Plate 1, fig. 5

Elytron 5.5 mm. long, 2.5 mm. wide; black, moderately convex, apex very obtuse, eight punctured striae, the punctures small and round, striae separated by distances much greater than those between successive punctures.

Sunchal, Argentina, in rock of Tertiary age. Named after the discoverer of the first Tertiary insects known from Argentina.

Holotype.—Cat. No. 70813, U.S.N.M.

CURCULIONITES JUJUYENSIS, new species

Plate 1, fig. 6

Elytron 2.5 mm. long, 1 mm. wide; pale brown, moderately convex, apex obtuse but subangulate; nine rows of strong, large punctures, over 20 in a row.

Sunchal, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70814, U.S.N.M.

CURCULIONITES WIELANDI, new species

Plate 1, fig. 8

Elytron 4 mm. long, 1.8 mm. wide; dark reddish brown, apex obtuse; nine rows of rather small punctures, obsolete in apical region.

Sunchal, Argentina, in rock of Tertiary age. Named after Dr. G. R. Wieland, who was the first to find fossil insects in Argentina.

Holotype.—Cat. No. 70815, U.S.N.M.

TENEBRIONITES INCLINANS, new species

Plate 1, fig. 7

Elytron 4 mm. long, 2 mm. wide; brown, base broadly truncate, apex obtusely subangulate, surface finely rugulose, without punctures or striae; a short angulate ridge near scutellar margin.

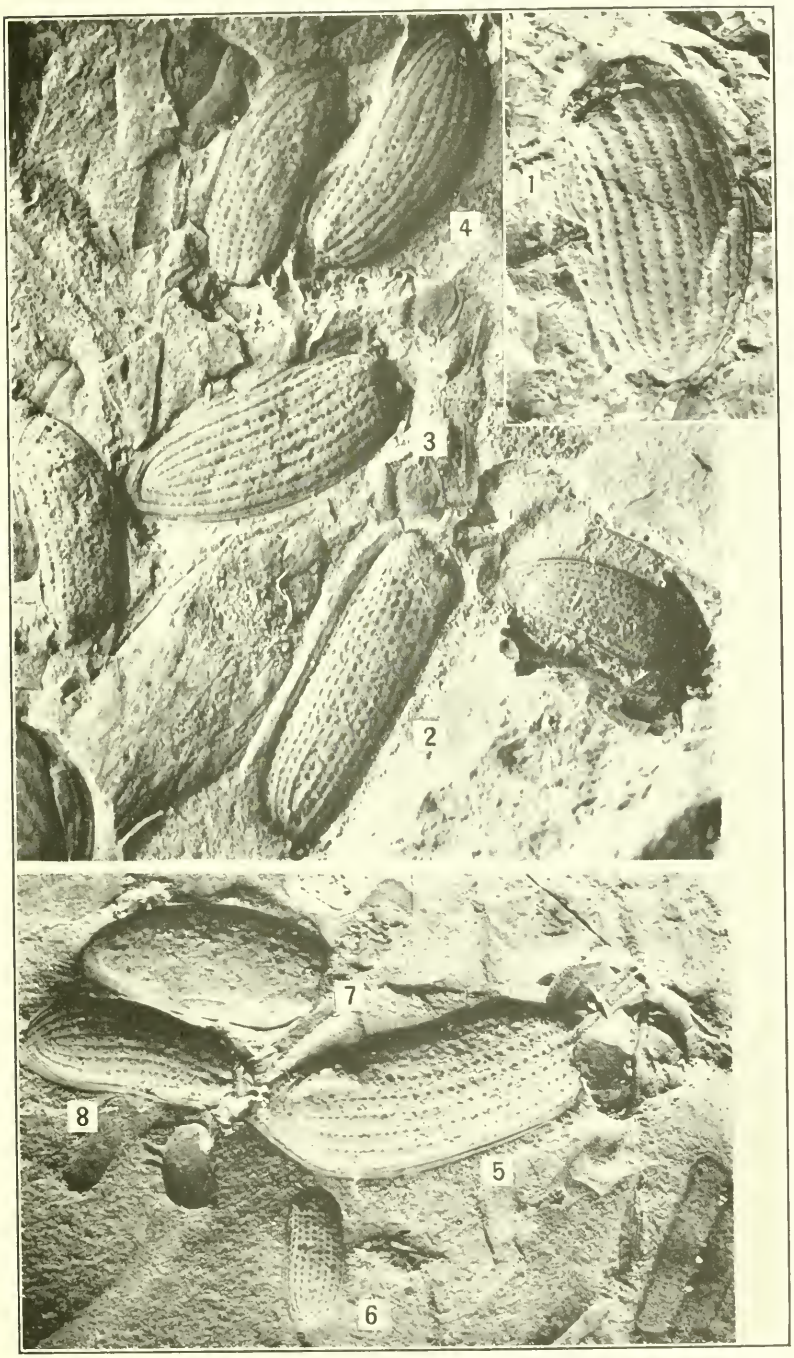
Sunchal, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70816, U.S.N.M.

Certainly not congeneric with *Tenebrionites anglicus* Cockerell, the type of the genus, but placed here because of a certain general resemblance to Tenebrionidae.

EXPLANATION OF PLATE

FIG. 1. *Otiorhynchites aterrimus.*
2. *Cossonus devoratus.*
3. *Anthonomus sunchalensis.* Type.
4. *Anthonomus sunchalensis* (Another example.)
5. *Curculionites harringtoni.*
6. *Curculionites jujuyensis.*
7. *Tenebrionites inclinans.*
8. *Curculionites wielandi.*



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FOR EXPLANATION OF PLATE SEE PAGE 5

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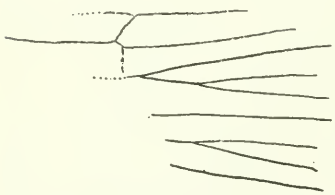

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Elytron dark reddish brown; length 5 mm., breadth 2.4 mm.; outer (upper) margin gently convex, apex obtusely angled. Nine fine punctate striae, the punctures small and somewhat elongate, over 30 in each stria; distance between successive punctures about half the distance between striae; the striae converge apically, the innermost meeting some distance before the apex. A delicate linear groove runs parallel with and close to the margin.

Sunchal, Dept. Sta. Barbara, Prov. Jujuy, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70812, U.S.N.M.

The arrangement of the striae suggests *Anthonomus*, but of course whatever scales (or pubescence) may have existed have been lost. The type is on the same piece of rock as *Cossonus devoratus*, and less than 2 mm. from it. Other elytra of *A. (?) sunchalensis* are on the same rock.

CURCULIONITES HARRINGTONI, new species

Plate 1, fig. 5

Elytron 5.5 mm. long, 2.5 mm. wide; black, moderately convex, apex very obtuse, eight punctured striae, the punctures small and round, striae separated by distances much greater than those between successive punctures.

Sunchal, Argentina, in rock of Tertiary age. Named after the discoverer of the first Tertiary insects known from Argentina.

Holotype.—Cat. No. 70813, U.S.N.M.

CURCULIONITES JUJUYENSIS, new species

Plate 1, fig. 6

Elytron 2.5 mm. long, 1 mm. wide; pale brown, moderately convex, apex obtuse but subangulate; nine rows of strong, large punctures, over 20 in a row.

Sunchal, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70814, U.S.N.M.

CURCULIONITES WIELANDI, new species

Plate 1, fig. 8

Elytron 4 mm. long, 1.8 mm. wide; dark reddish brown, apex obtuse; nine rows of rather small punctures, obsolete in apical region.

Sunchal, Argentina, in rock of Tertiary age. Named after Dr. G. R. Wieland, who was the first to find fossil insects in Argentina.

Holotype.—Cat. No. 70815, U.S.N.M.

TENEBRIONITES INCLINANS, new species

Plate 1, fig. 7

Elytron 4 mm. long, 2 mm. wide; brown, base broadly truncate, apex obtusely subangulate, surface finely rugulose, without punctures or striae; a short angulate ridge near scutellar margin.

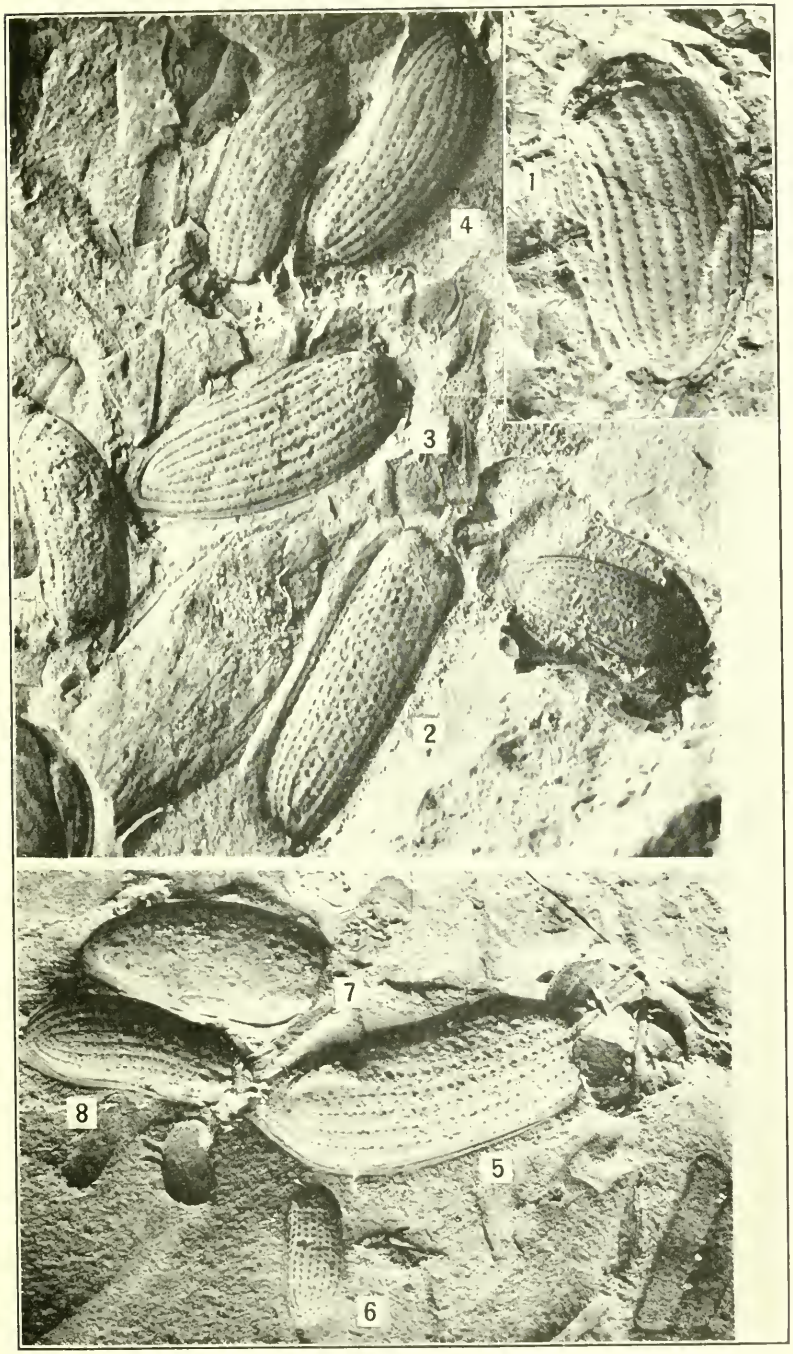
Sunchal, Argentina, in rock of Tertiary age.

Holotype.—Cat. No. 70816, U.S.N.M.

Certainly not congeneric with *Tenebrionites anglicus* Cockerell, the type of the genus, but placed here because of a certain general resemblance to Tenebrionidae.

EXPLANATION OF PLATE

FIG. 1. *Otiorhynchites aterrimus.*
2. *Cossonus devoratus.*
3. *Anthonomus sunchalensis.* Type.
4. *Anthonomus sunchalensis* (Another example.)
5. *Curculionites harringtoni.*
6. *Curculionites jujuyensis.*
7. *Tenebrionites inclinans.*
8. *Curculionites wielandi.*



TERTIARY INSECTS FROM ARGENTINA

FOR EXPLANATION OF PLATE SEE PAGE 5

DESCRIPTIONS OF NEW INTERNAL PARASITES

By Edward A. Chapin
Of the Bureau of Animal Industry, United States Department of Agriculture

Among the collections made by Dr. Alexander Wetmore, while a member of the U. S. S. *Tanager* Expedition of 1923 under the joint auspices of the Biological Survey, United States Department of Agriculture, and the Bishop Museum of Honolulu, were two lots of nematodes and one of cestodes, representing as many species. Both of the nematode species proved to be new to science and are herewith described. According to Doctor Wetmore, all of the monk seals (*Monachus schauinslandii*) which were examined for parasites had nematoda in abundance within the stomach. Owing to the exigencies of the situation, it was difficult to preserve parasitic material and only samples were obtained. He also says that, so far as his memory serves, the wall of the stomach of a parasitized animal did not show ulcers. This condition indicates that there may be a division of the genus *Contracaecum* into ulcer-forming and nonulcer-forming species just as there is in the genus *Heterakis*.

NEMATODA

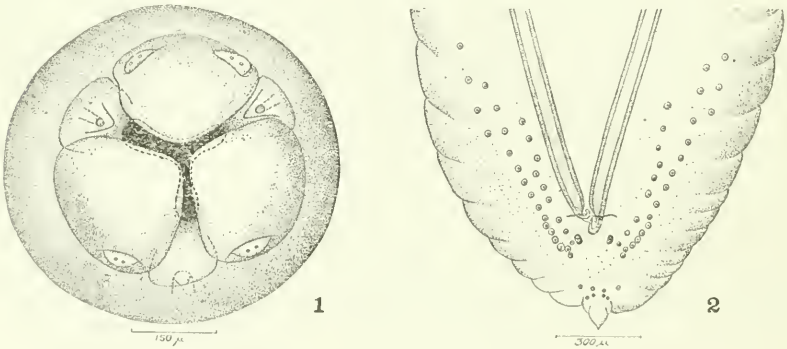
FAMILY ASCARIDAE

CONTRACAECUM TURGIDUM, new species

Male: Length 45 mm., greatest diameter 1.8 mm., near the middle of the body length. Lips large and nearly quadrate, subequal, 210μ high. Dorsal lip bears two double papillae, each subventral lip with a single double papilla. Interlabia comparatively large; those adjacent to the dorsal lip carry the amphids which appear in transverse section as circular spaces. Excretory pore opens at the base of the ventral interlabium; 75μ behind the base of the lips is a rather deep constriction, causing the anterior portion of the neck region to assume a collarlike form. Cervical papillae oval, slightly prominent, 47μ behind the cervical constriction. Esophagus 6.3 mm. long. Intestinal appendix six-elevenths as long as esophagus, esophageal ap-

pendix one-third as long as esophagus. Cloaca 390μ before posterior extremity of worm, which bears a conical appendage 120μ long. The usual pair of double papillae are situated 100μ behind the cloaca and are separated by an interval of 85μ. Outside the double papillae and extending some distance before and behind the cloaca is, on each side of the worm, a group of twenty-seven papillae. Of these ten are behind the transverse level of the cloaca. Just before the caudal appendage there is a median group of eight papillae, arranged in two rows of four each. Extending forward from each lateral group of papillae is a row of about twenty papillae, the last member of which is about ten millimeters in front of the cloaca. The spicules are very long; the right measures 12 mm., the left 11.8 mm.

Female: Length 62 mm., greatest diameter 2.8 mm., near middle of body length. Lips similar in form and arrangement to those of the male, lips 150μ high, interlabia slightly less. Labial papillae as



FIGS. 1–2.—CONTRACAECUM TURGIDUM. 1, FRONT VIEW OF HEAD. 2, CAUDAL EXTREMITY OF MALE

in male. Amphids and excretory pore as in male. Cervical constriction 105μ behind base of lips. Esophagus 6 mm. long, relative lengths of the appendices as in male. Vulva near anterior third of body length, vagina short, oviduct thick and muscular, about 2 mm. long, bifurcating to form two voluminous, thin walled uteri both of which are directed posteriad. Anus 800μ before the porterior extremity. Tail conical, rapidly narrowing to the caudal spike which is 15μ in length. Eggs spherical to ovate, averaging 60μ by 54μ, with smooth thick shells.

Habitat.—In stomach of *Monachus schauinslandii*, April 8, 1923, Alex. Wetmore.

Locality.—Hawaii, Laysan Island.

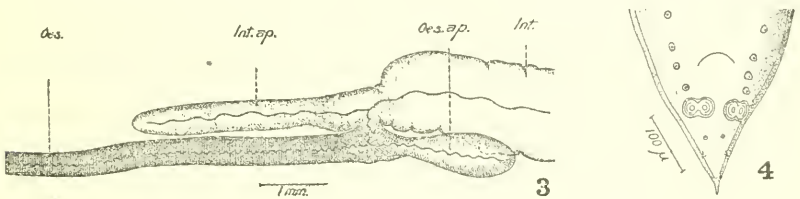
Type.—U. S. N. M. Helminthological Collection No. 26202, Paratypes No. 26203, and in the collections of the Bishop Museum.

It may be noted that in the above-described species, as well as in all other species of this genus that the writer has examined, the

interlabia carry certain definite organs. The submedian dorsal interlabia contain the amphids which according to Steiner are sense organs of the olfactory or gustatory type. The ventral interlabium supports in its lower part the terminal portion of the excretory duct. It may be that these interlabia are modified papillae.

CONTRACAECUM MAGNIPAPILLATUM, new species

Male: Length 20 mm., greatest diameter 585μ, near middle of body length. Lips subequal, each broader across base than high, height 75μ. Interlabia slightly less high, subtriangular. Labial papillae as in *C. turgidum*. Amphids in interlabia adjacent to dorsal lip, excretory pore near base of ventral interlabium. Cervical constriction 75μ behind base of lips. Cervical papillae 645μ behind base of lips, oval, slightly prominent. Esophagus 3.2 mm. long, esophageal appendix three-fourteenths, intestinal appendix three-fourths as long as esophagus, respectively. Cloaca about 200μ before the posterior extremity, which ends in an acutely conical tip 13μ long. Double papillae proportionately very large, the boss upon which either pair



FIGS. 3–4.—3, CONTRACAECUM TURGIDUM. ANTERIOR PORTION OF DIGESTIVE TRACT, SHOWING ESOPHAGEAL AND INTESTINAL APPENDAGES. 4, CONTRACAECUM MAGNIPAPILLATUM. CAUDAL EXTREMITY OF MALE

is placed measures 43μ by 23μ. The two bosses are separated by a distance equal to the shorter diameter of either. The interval between the cloaca and one of the double papillae is 26μ. Behind the double papillae there are four single papillae, two of which are submedian, the other pair sublateral and slightly more prominent. Proceeding forward from each double papillae is a single row of twenty-one single papillae, the last member of which is about 4 mm. in front of the cloaca. The spicules are equal and similar, 3.8 mm. long, tips acute, not modified as in *C. turgidum*.

Female: Length 23 mm., greatest width 750μ, just behind the vulva. Anterior portion similar to that of male. Esophagus 3.37 mm. long, ratios of length of esophagus to that of appendices virtually the same as in the male. Vulva on a slight prominence, 8 mm. behind the anterior extremity, or about the anterior third of the body length. Vagina short (120μ) and straight, opening into a muscular and somewhat sinuous oviduct about 2 mm. long. Oviduct bifurcates to

form two posteriorly directed uteri. Anus 300μ before the posterior extremity, which is conical with a terminal spike 10μ long. Eggs oval, 68μ by 45μ, with thin shells.

Habitat.—In *Megalopterus hawaiiensis*, organ not stated, May 17, 1923, Alex. Wetmore.

Locality.—Hawaii, Lisianski Island.

Type.—U. S. N. M. Helminthological Collections No. 26204; paratypes No. 25454, and in the collections of the Bishop Museum.

In comparing the two species described above, the dissimilarity in the distribution of the caudal papillae of the males is at once evident. So far as the writer is aware, the arrangement as seen in *C. magnipapillatum* is entirely different from any other species, while that of *C. turgidum* is quite typical. Material representing five species, including the above, has been examined and reference has been made to the remainder of the described species. The eggs of these two species are also conspicuously different in the character of the shell. It may be that when other species of *Contracaecum* have been recovered from other species of terns, a new genus, or at least a subgenus, will be indicated.

CESTODA

Family BOTHRIOCEPHALIDAE

BOTHRIOCEPHALUS, species

Two specimens of a species of *Bothriocephalus* close to and possibly identical with *B. hians* (Diesing) were collected from *Monachus schauinslandii* April 8, 1923, by Doctor Wetmore. The author does not feel that differentiation of the species in this genus should be undertaken without the expenditure of considerable time for study and without the examination of a moderately complete collection of authentic material. As neither time nor material is at present available, the specimens (U. S. N. M., Helm. Coll. No. 26205) are left with generic identification only.

SYSTEMATIC NOTES ON AND DESCRIPTIONS OF NORTH AMERICAN WASPS OF THE SUBFAMILY BRACHYCISTIINAE

By J. R. Malloch,

Of the Bureau of Biological Survey, U. S. Department of Agriculture

In this paper are presented data obtained from a study of previously unidentified specimens in the collection of the Biological Survey and in the United States National Museum. This study was undertaken for the purpose of identifying a large number of species in the first-named collection which in their unidentified condition were of little value for comparative purposes to members of the Division of Food Habits Research in so far as specific names were concerned. An intensive study of the anatomy of the groups dealt with was undertaken and drawings of the more important structures made by means of which it may be possible to identify, at least generically, even fragments of these insects such as are most frequently met with in the stomach contents of birds and other insectivorous animals. In this paper the illustrations deal with specific rather than group characters for the greater part, and where there are good figures in previously published papers of other authors these have not been duplicated.

One of the problems facing me at the start of this work was the status of the family Psammocharidae, as well as its position in the scheme of classification. The structure of the prothorax has for many years been considered to link this group with the Scoliidae, Mutillidae, and Sapygidae rather than with the Sphecoid complex; but I am not inclined to that opinion. In fact from a consideration of all the anatomical details of members of these groups I lean to the opinion that in the structure of the prothorax, and even more obviously in other characters both of biology and structure the Psammocharidae are more closely related to Sphecoidea than to Scoliidae. In a paper dealing with Psammocharidae I will enter more into details of these relationships.

Another problem that presented itself was the allocation of the genus *Brachycistis*. This genus has most recently been considered as belonging to the same group as Myrmosa and more specifically

as a member of the family Myrmosidae, though at one time the species now placed in the genus were considered as belonging to Mutillidæ and were linked with species of *Cyphotes* under that generic designation. It is my opinion that *Brachycistis* belongs to the Scoliidæ of which it should form a subfamily, or if one considers the major group as a super-family then it should be considered as a family in the complex. This family or subfamily status is largely a matter of opinion and until we have advanced farther in our knowledge of the Hymenoptera as a whole throughout the entire range of their occurrence a dogmatic opinion would be ill-advised.

Realizing that this work is merely a small contribution to the elucidation of the classification of the group upon which it is based and that with future accessions both of species and of workers it must be carried much farther I have deposited practically all my dissected specimens and types as well as all uniques and specimens not absolutely necessary for carrying on the work of the bureau of which I am a member in the collection of the United States National Museum where they will be accessible to any interested student.

Family SCOLIIDAE

In this family the pronotum is carried backward at its upper posterior angles to a point above the level of the tegulae where there is a rather sharp angle (fig. 1, 1a); the mesosternum is carried backward over or between the bases of the mid coxae in the form of a cleft plate; the apical ventral segment of the abdomen in the males is produced in the form of a single curved spine (figs. 2, 3) or three such spines; the hind wing has the anal lobe present; the basal tergite of abdomen has a linear sulcus below spiracle extending from base to apex, beyond which the margin is flexed ventrad, closely adhering to surface of the sternite.

I present a key for the separation of the four subfamilies of Scoliidae that occur in North America. The females of Brachycistiinae are unknown, unless my surmise is correct that *Mutilla peculiaris* Cresson belongs here, an opinion that is expressed later on in this paper.

Subfamily BRACHYCISTIINAE

This subfamily is distinguished from the Myrmosidae by the venation of the fore wings (figs. 4, 5, 6), in which they more closely resemble Photopsinae; the forward opening antennal sockets; presence of a scalelike extension of the mesosternum between the bases of the mid coxae; the spinelike structure of the eighth abdominal sternite, in which character they are similar to Tiphiinae; the structure of the male hypopygium; and the lack of a platelike extension on hind coxae.

The claws are simple; there is no stripe of fine short hairs on sides of second abdominal tergite in the males as in Mutillidae; the fore coxae possess a stridulatory area in most of the males; there is a distinct marginal vein as in Scoliinae, and Eliinae, though the connection of this vein with the one behind it at apex is different in Brachycistiinae from that shown in any of the related groups (figs. 7–11). In Brachycistiinae the cerci are absent, or at least not developed papilliform, in which character they are similar to Scoliinae and Tiphiinae, though these organs are present in Eliinae, and in Mutillidae and Myrmosidae (figs. 12, 13).

In Tiphiinae we have the same forwardly opening antennal sockets as in this subfamily, but the mesosternum and metasternum differ as indicated in the key presented below.

KEY TO SUBFAMILIES OF SCOLIIDAE

1. Antennal sockets directed obliquely laterad because of an abnormal development of the inner rim of each or an elevation of the intervening area; females winged ..... 2.
   Antennal sockets directed forward, no abnormal development of the inner rim nor elevation of the intervening area ..... 3.
2. Metasternum broad and almost flat, consisting of two large, medially divided plates, the hind coxae widely separated ..... Scoliinae.
   Metasternum small, consisting of two tuberculiform plates, the hind coxae contiguous or subcontiguous ..... Eliinae.
3. Tegulae entirely covering the antitegulae; metasternum large, on same plane as mesosternum or almost so, between the posterior plates of which it projects deeply as a triangular wedge; females always winged ..... Tiphiinae.
   Tegulae normal, the antitegulae fully exposed; metasternum depressed, usually with two erect processes in front of hind coxae, or elevated ridge like on median line; females apterous ..... Brachycistiinae.

It appears to me that even using Ashmead's key to the families of Vespoidea *Brachycistis* males will run down to the vicinity of Tiphiidae and not to Myrmosidae, the mid coxae being overlaid basally by the posterior plates of the mesosternum and, though actually subcontiguous, quite as much separated as are those of some males of *Elis*, etc. The backward extensions of the mesosternum are lacking in the female which I assign here but the mid coxae are very widely separated.

I have but little hesitation in allocating as the female of *Brachycistis* the species upon which the genus *Typhoctes* was based, *peculiaris* Cresson. This sex which is known to me only from a single specimen, the type of *mirabilis* Cockerell, in the National Museum, and apparently the specimen used by Ashmead in describing *Typhoctes*, differs from the males of *Brachycistis* in having two apical spurs on the mid tibia, and a longitudinal stripe of short hairs on each side of the second abdominal tergite. Despite these discrepancies and the lack of wings I consider that this is the female of a species of

Brachycistis, the other anatomical features being very much in favor of this view. I present a sketch of the thoracic anatomy from the side, showing the oblique pleural suture similar to that of males of *Brachycistis* (fig. 14), and the basal segment of the abdomen is absolutely identical with that of the more robust males of that genus, while absolutely different from that of males of *Cyphotes* with which it has been more closely linked in the past (figs. 15, 16).

Males of *Brachycistis* are commonly attracted to lights where the species occur and when running about give forth a squeaking sound according to R. C. Shannon who collected specimens in Washington State. It may be of interest to state that I had noted the "stridulatory areas" on the fore coxae before I knew of the ability of these insects to produce sound, and that confirmation of my conjecture that the insects stridulate was obtained from Mr. Shannon before he knew of my discovery. How these areas are used to produce sound or even if my surmise that they are so used is correct I do not know, but observation of living specimens will probably produce evidence if these areas are utilized in this manner.

Professor Cockerell in replying to a letter of mine in which I suggested that *mirabilis* might be the female of a species of *Brachycistis* states that so far as he knows the former is diurnal and the *Brachycistis* males are nocturnal. However, he informs me that repeated searches with a lantern after dark in localities where the males abounded failed to disclose any females of the genus, apparently bearing out the supposition we both entertain that the females remain underground.

In the summer of 1924 the Biological Survey had E. R. Hall in the field at Pyramid Lake, Nev., and he picked up many specimens of the genus *Brachycistis* which I have before me. A large number of these specimens were taken by sweeping alfalfa between the hours of 5 and 7 p. m. Others were taken at light. I give an extract from Mr. Hall's letter to me in reply to an inquiry of mine regarding the habits of these species.

> The specimens of Hymenoptera labeled as having been swept from alfalfa were taken as early as 5 p. m. and as late as 7 p. m. While those taken at the latter hour might be said to be crepuscular, none of the sweepings from alfalfa were made after dark and the ones taken as early as 5 p. m. might indicate a diurnal habit. Large numbers were also taken at night under my light as indicated on the labels. I noticed that these insects produced a slight sound but did not determine how this was accomplished.

It is of interest to note that all the specimens of *atrata* Blake in this lot were swept from alfalfa, not one bearing a label to the effect that this black species occurred at light. Most of the orange colored specimens were taken at light, but a few have the same label as

atrata and some others have no label to indicate how they were taken.

This record of the occurrence of a species in the daytime is of interest as the general opinion is that they are strictly nocturnal.

Genus BRACHYCISTIS Fox

The subfamily contains but one genus, which is divisible into at least three well defined segregates, one of which is made use of herein for the first time. These segregates, which I accept as subgenera, may be distinguished as in the following key.

KEY TO SUBGENERA

1. Mandibles with at most two teeth, sometimes with only a slight angle in addition to the apical tooth; fore wing with both recurrent veins and either two or three submarginal cells ..... **Brachycistina**, new subgenus, p. 25.
   Mandibles with two distinct teeth in addition to the apical one, or the second recurrent vein is lacking in forewing ..... 2.
2. Only one recurrent vein present in fore wing; fore coxae without a stridulatory area ..... **Brachycistellus** Baker.
   Two recurrent veins present in fore wing; fore coxae with distinct stridulatory area ..... **Brachycistis** Fox, p. 5.

Subgenus BRACHYCISTIS Fox

This subgenus contains most of the species and though these may be separated into segregates by more or less marked structural characters the groups are not so clearly differentiated that they can be considered as entitled to subgeneric status. I append a key to these groups and on subsequent pages keys to the species of each group known to me.

KEY TO SPECIES GROUPS

1. Second abdominal sternite with a short longitudinal carina at base. **aequalis** group, p. 7.
   Second abdominal sternite without a longitudinal carina at base ..... 2.
2. Prepodeum with a sharp carina between the anterior horizontal and posterior declivous portions, or with irregular transverse rugae on upper part of hind surface ..... 3.
   Propodeum without a distinct transverse carina or obvious transverse rugae as above ..... 4.
3. Second submarginal cell of fore wing almost as long as first; but one round pitlike depression situated diagonally between metathoracic spiracle and suture; hind coxae sharp on postero-ventral (inner) surface, usually with a conspicuous sharp carina ..... **castanea** group, p. 9.
   Second submarginal cell of fore wing very much shorter than first, averaging about half as long; two distinct pitlike depressions between the metathoracic spiracle and suture, one much above the other, postero-ventral margin of hind coxae rounded ..... **carinata** group, p. 10.
4. Fore wing with but two submarginal cells ..... **brevis** group, p. 11.
   Fore wing with three submarginal cells ..... 5.

5. Third submarginal cell of fore wing normally higher than long, the vein closing it outwardly interstitial with the cross vein from hind margin of stigma, or even proximad of it ..... **gaudii** group, p. 13.
   Third submarginal cell of fore wing subquadrate or longer than high, the vein closing it outwardly much beyond the cross vein from hind side of stigma ..... 6.
6. Head very conspicuously narrowed posteriorly, the sides converging from directly behind eyes when seen from above ..... **ampla** group, p. 14.
   Head normal, sides when seen from above generally parallel or subparallel for a short distance behind eyes ..... 7.
7. Space between antennal socket and eye not over one-half as wide as one socket; posterior ocelli separated from eye by a distance not greater than the transverse diameter of either ocellus; anterior extremities of gular carina visible from side except in *nigripes* ..... **inaequalis** group, p. 15.
   Space between antennal socket and eye distinctly more than half as wide as socket ..... 8.
8. Posterior ocelli separated from eye by a space at least 1.5 as wide as one ocellus ..... **micrommata** group, p. 17.
   Posterior ocelli separated from eye by a space less than 1.5 as wide as one ocellus ..... 9.
9. Gular carina not elevated and deflected outwardly at or near its anterior extremities, never visible when head is viewed directly from the sides; vein emanating from apical costal margin of stigma extending along costa as far as or farther than length of the cross vein emanating from hind side of stigma ..... **nitida** group, p. 20.
   Gular carina with its anterior extremities visible when head is seen from the side, or if these elevations are not visible, or indistinctly so, the vein emanating from apical costal margin of stigma bends down at, or very close to, its base and does not run along costa as far as stated in last section. **atrata** group, p. 22.

Bradley separates two species, *eriopis* Bradley and *arenivaga* Bradley, from all the others on the structure of the basal segment of the abdomen. In these two this segment has no basal neck and there is no dorsal, and scarcely any lateral, constriction between it and the second segment. I have seen no specimens that possess this character. Bradley figures the hypopygium of *arenivaga* and, though the details are not very clear, it evidently is very similar to that of *atrata* Blake, as is also the venation of the fore wing, which he figures, too.

Bradley included 30 species of *Brachycistis* in the restricted sense in his paper. Of these I have seen 22 and some of the others are included in my keys on the strength of characters given by Bradley. A few are omitted as it is impossible for me to include them owing to the descriptions lacking characters which are essential to my placing them in my paper. The omitted species include *perpunctata* Cockerell *petiolata* Fox, *ioachinensis* Bradley, *nuda* Fox, *subquadrata* Fox, and the two already referred to. I believe that the absence of the carina on the upper margin of occiput will readily distinguish the first-named species from any other yet described, and *nuda* Fox appears to me to be a synonym of *atrata*, which Bradley evidently suspected from his remark that it was "doubtfully distinct from *atrata*."

LIST OF SPECIES

AEQUALIS GROUP

1. *idiotes* Cockerell.
2. *noctivaga* Bradley.
3. *aequalis* Fox.
4. *normalis* Malloch.

CASTANEA GROUP

5. *crassa* Bradley.
6. *stygia* Bradley.
7. *castanea* Cresson.
8. *thermarum* Bradley.

CARINATA GROUP

9. *rugosa* Malloch.
10. *carinata* Fox.
11. *subcarinata* Malloch.

BREVIS GROUP

12. *texana* Malloch.
13. *brevis* Fox.
14. *eremi* Bradley.

GAUDII GROUP

15. *gaudii* Cockerell.
16. *parva* Malloch.

AMPLA GROUP

17. *ampla* (Blake).
18. *protractor* Bradley.

INAEQUALIS GROUP

19. *nigrifrons* Malloch.
20. *inaequalis* Fox.
21. *curvata* Malloch.
22. *utahensis* Malloch.
23. *alcanor* Blake.
24. *dentata* Bradley.

MICROMMATA GROUP

25. *micrommata* Bradley.
26. *intermedia* Malloch.
27. *melanocephala* Malloch.
28. *verticalis* Malloch.
29. *dakotensis* Malloch.

NITIDA GROUP

30. *nevadensis* Fox.
31. *nitida* (Cresson).
32. *washingtona* Malloch.
33. *glabrella* Cresson.

ATRATA GROUP

34. *atrata* (Blake).
35. *imitans* Malloch.
36. *lacustris* Malloch.
37. *indiscreta* Fox.
38. *semiatra* Malloch.
39. *triangularis* Cresson.

AEQUALIS group

Characters.—Second abdominal sternite with a conspicuous longitudinal carina on basal portion; distance from apex of stigma to apex of marginal cell not less than two-thirds as great as length of stigma; propodeum with a distinct transverse carina between horizontal and declivous sections; hind coxae without a longitudinal carina on their posteroventral, or inner opposed surfaces. Male hypopygium as in figure.

KEY TO SPECIES

1. Basal segment of abdomen when seen from above at least 2.5 as long as its apical width, when seen from the side about three times as long as its greatest height; sternal carina short and not very high---**idiotes** Cockerell.
   Basal segment of abdomen when seen from above distinctly less than twice as long as its apical width, when seen from the side not over twice as long as its greatest height---2.
2. Carina of gular orifice produced into a sharp elevation at its anterior extremity which is plainly visible from the side when the head is held in a vertical position---**noctivaga** Bradley.
   Carina of gular orifice not exceptionally elevated at its anterior extremity which is not visible when the head is held in a vertical position---3.
3. Basal abdominal segment about twice as long as its apical width when seen from above; apical edge of clypeus very little elevated---**aequalis** Fox.
   Basal abdominal segment distinctly less than twice as long as its apical width when seen from above; apical edge of clypeus quite noticeably elevated---**normalis**, new species.

BRACHYCISTIS (BRACHYCISTIS) IDIOTES Cockerell

A large slender species with the same form of hypopygium as *noctivaga*, in fact there are no outstanding distinctions between these organs in any of the four species of the group, all of which I have examined. The characters listed in the key appear to warrant the specific separation of the four forms. The inner one of the paired processes of hypopygium (Sagitta of Bradley) is shorter than in *normalis* (fig. 43), otherwise the hypopygium is similar.

Length, 15–18 mm.

Originally described from Las Cruces, N. Mex. I have seen it from Keeler, Calif., November 14, 1914 (A. Wetmore).

BRACHYCISTIS (BRACHYCISTIS) NOCTIVAGA Bradley

A much stouter species than the last, the first abdominal segment being conspicuously stouter. The quite conspicuous elevation of the gular carina at its anterior extremity (fig. 30) readily separates this species from the next two, but in this character it is similar to *idiotes*.

Length, 12–14 mm.

Originally described from Las Vegas, Nev. I have before me specimens from Arlington, Higley, and Mount Superstition, Ariz., and one from Utah without more definite locality.

BRACHYCISTIS (BRACHYCISTIS) AEQUALIS Fox

This species has the first abdominal segment more elongate than in *noctivaga* or *normalis*, and in the specimen before me there is an irregular transverse carina on first tergite just behind the spiracles. The occiputal carina in this species is as shown in Figure 29. The marginal cell of fore wing is about as long on costal margin as the stigma.

Length, 12 mm.

Recorded from Colorado, Nevada, and Arizona. The only specimen I have seen is from Arizona.

BRACHYCISTIS NORMALIS, new species

Male.—Similar to *noctivaga* in all respects except the structure of the gular carina. Hypopygium as in figure 43.

Length, 12–14 mm.

Holotype.—Cedar Pass, S. Dak. (W. H. Over). Paratypes, two, San Simon, Ariz. (Hubbard), one, Colorado (C. F. Baker), one, Los Angeles county, Calif.

Type.—Cat. No. 27909, U. S. N. M.

CASTANEA group

Characters.—Hind coxae sharply carinate on posteroventral margins, less conspicuously so in *thermarum* Bradley; propodeum with a distinct transverse carina as in *idiotes* group; second submarginal cell of fore wing about as long as first; second sternite of abdomen without a longitudinal carina; first abdominal segment not twice as long as its apical width when seen from above; mid and hind tibiae with distinct dorsal bristles or spines; only one pit below metathoracic spiracle instead of the usual two.

KEY TO THE SPECIES

1. Second abdominal sternite with a transverse elevation near base; first tergite with a similar but less distinct ridge or elevation near middle------crassa Bradley.
   Second sternite and first tergite normal, without transverse elevations----2.
2. Deep black species----------stygia Bradley.
   Castaneous or brownish orange colored species----------3.
3. Hind coxal carinae very sharp and conspicuous--------castanea Cresson.
   Hind coxal carinae more rounded, inconspicuous--------thermarum Bradley.

BRACHYCISTIS (BRACHYCISTIS) CRASSA Bradley

This is the only known species of the genus in which the second abdominal tergite is transversely carinate near base. The hypopygium is quite distinct from that of any other species of the genus belonging to any group. The figures which I present of the organ (figs. 44, 45) are considerably different from those given by Bradley for this species, but the disparity may be due to a difference of viewpoint, or to individual variation within the same species. The two small figures given above the uncus show lateral and end views of that organ.

All the species of the group except *stygia* are brownish-orange or castaneous in color, the head being but little if any darker than the thorax. Bradley gives good figures of the wings of all four species, showing their striking similarity.

Length, 13–15 mm.

Originally described from southern California. I have before me specimens from Graham Mountains, Tucson, Arlington, Fort Grant, and Gila Valley, Ariz.

BRACHYCISTIS (BRACHYCISTIS) STYGIA Bradley

A robust, coarsely punctate black species which is conspicuous from the more slender shining black species like *gaudii* Cockerell and *atrata* Blake by its larger size, 13–15 mm. in length, and the characters listed in key to groups. I present figures of the hypopygium (figs. 42, 46).

Originally described from Arizona. I have before me a series of specimens taken at Higley and Mount Superstition, Ariz.

BRACHYCISTIS (BRACHYCISTIS) CASTANEA Cresson

Apparently a fairly common species. Recorded from Colorado, New Mexico, and Lower California. I have seen specimens from Arizona, Texas, and California. The hypopygium differs slightly from that of *stygia* as shown by the sectional drawings 46, *a*, *b*, and *c*.

BRACHYCISTIS (BRACHYCISTIS) THERMARUM Bradley

This species has the hind coxae less distinctly carinate than the others in the group, and the hypopygium is rather different in some particulars as shown in figure 46 and 47.

Length, 11 5–13 mm.

Originally described from Hot Springs, Ariz. I have seen specimens from Higley, Mount Superstition.

CARINATA group

Characters.—Propodeum with one sharp or well-defined carina demarcating the horizontal anterior and declivous posterior parts, or there are several more or less irregular transverse carinae on the upper margin of the declivous part; hind coxae rounded on postero-ventral margins; second abdominal sternite more carinate; first segment longer than its apical width.

The species in this group, despite the presence of a more or less obvious transverse carina on the propodeum, appear to be more closely related to the *atrata* group than to the *castanea* group, judging from the structure of the hypopygium (fig. 43).

Throughout the group the head is black, the hind coxae are not carinate, and the second submarginal cell of the fore wing is much shorter than the first, readily distinguishing them from the pale colored species of the *castanea* group.

There appear to be three species in the group represented in my material. I find very little structural variation in the large series of *carinata* which I have examined from a single locality and were it not for this fact I might be inclined to consider the specimens here described as new species to be merely aberrant examples of *carinata*. The hypopygia present no tangible differences, but this is not unusual in this genus where other and striking structural distinctions evidently outweigh the evidence of the hypopygia in separating species in several of the groups.

KEY TO SPECIES

1. Dorsum of propodeum irregularly transversely rugose, the division between the dorsal and hind surfaces with two irregular rugae; basal segment of abdomen about three-fourths as wide as at apex as it is long----------
----------rugosa, new species.

Dorsum of propodeum without transverse rugae, finely shagreened, and with a median sulcus----------2.

2. Division between dorsal and hind surfaces of propodeum marked by a single carina which is usually quite sharp; basal segment of abdomen nearly twice as long as its apical width ..... carinata Fox.
Division between dorsal and hind surfaces of propodeum marked by two or more irregular series of transverse rugae; basal abdominal segment with its apical width fully two-thirds as great as its length ..... subcarinata, new species.

BRACHYCISTIS (BRACHYCISTIS) RUGOSA, new species

Male.—Similar to *carinata*, but a little darker in color. Differs structurally in the characters listed in the key and as follows: Antennal sockets but little produced below, not sharply so; central beveled emargination of clypeus broader centrally, narrower laterally, the emargination deeper; anterior elevations of gular carina higher, visible when head is viewed directly from the side.

Length, 12 mm.

Holotype.—Golconda, Nev. September, 1915 (J. R. Bunch).

Type.—Cat. No. 27910, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) CARINATA Fox

This species is more slender than *rugosa*. Hypopygium as in figure 48.

Length, 12–14 mm.

Originally described from La Jolla, Calif., from which locality I have seen a specimen in the United States National Museum. A large series from San Diego in same collection.

BRACHYCISTIS (BRACHYCISTIS) SUBCARINATA, new species

Male.—Very similar to *carinata*, differing as stated in key and as follows: Head almost as in *rugosa;* propodeum more nearly vertical behind; color darker.

Length, 12 mm.

Holotype.—Higley, Ariz., June 18, 1917, at light (E. G. Holt).

Paratype.—Arlington, Ariz., June 16, 1919, at light (A. Wetmore).

Type.—Cat. No. 27911, U.S.N.M.

BREVIS group

Characters.—Only two submarginal cells in fore wing; propodeum without a transverse carina; second abdominal sternite not carinate; hind coxae slightly carinate on posteroventral edge except in *texana*.

KEY TO SPECIES

1. Carina of gular orifice elevated into a prominent angle less than midway from hind to front margin (fig. 32); hind coxae rounded on posteroventral edges; clypeus with a rounded vertical elevation apicad of which the surface slopes slightly, the apical margin emarginate and flattened ..... texana, new species.
Carina of gular orifice not elevated about middle; clypeus with a more or less beaklike central eminence; hind coxae sharp, almost carinate on posteroventral edges ..... 2.

2. Carina of gular orifice quite noticeably elevated and very thin at anterior extremities ..... **eremi** Bradley.
Carina of gular orifice not more thinned nor elevated at anterior extremities than elsewhere ..... **brevis** Fox.

BRACHYCISTIS (BRACHYCISTIS) TEXANA, new species

Male.—Pale brownish-orange, tips of mandibles and stigma fuscous.

Posterior ocelli about 1.5 their own width from eye, separated from each other by about twice their own width, and from anterior ocellus by a space equal to the width of either; frons very sparsely punctured, and with no ridges in front, barely visible above antennae when head is viewed directly from side; clypeus with a quite prominent longitudinal broadly rounded eminence in center which has its apex about midway from upper to lower margin, the beveled portion of apical margin broader and less abrupt than usual, tooth on each side of central emargination distinct; space between edge and antennal socket a little narrower than socket, mandible with a ridge from base of inner tooth which becomes rounded from middle to base; gular carina as in Figure 32, the sharp angle nearer hind than front margin; antennae crenulate; pronotum almost vertical, not rugose; mesopleura with rather large punctures, most numerous anteriorly; propodeum broadly rounded above, rather abruptly declivous posteriorly, without ridges or depression above, the lateral upper margins with some setiforous punctures. First abdominal segment very little larger than its apical width, the constriction between it and second well defined; hypopygium as in Figure 49. Venation of forewing as in *eremi* Bradley. Mid and hind tibiae each with three or more quite strong dorsal bristles.

Length, 7 mm.

Holotype.—Cotulla, Tex., May 12, 1906, at light (Crawford and Pratt), Cat. No. 27912, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) EREMI Bradley

Very similar to *brevis* distinguished by the characters cited in key and in notes under last species. The minute hypopygial characters shown in figures 37–39 may not be sustained in a large series of specimens, but are the only distinctions I find in comparing single examples of the two species.

Length, 7–9 mm.

Originally described from Calexico, Calif. I have before me seven specimens from Higley, Mount Superstition, and Arlington, Ariz., June 15 and 16, and July 7 and 20 (A. Wetmore, E. G. Holt) and two specimens from Hot Springs, Ariz., June 22 and 26 (Barber and Schwarz). The last two specimens are from the National Museum collection, the others are from the collection of the Biological Survey.

BRACHYCISTIS (BRACHYCISTIS) BREVIS Fox

This species is sometimes distinguishable from *eremi* by the venational character cited by Bradley, consisting of the comparative length of the first and second submarginal cells, but not invariably so, as the second is sometimes nearly as long as first in both species. I have found however that the differences in the carinae surrounding the gular orifice present a reliable means for the separation of the species as cited in the key. The propodeal distinction cited by Bradley is not dependable, as both species show considerable variation in the degree of puncturation. The genitalia are strikingly similar, both having the same general habitus. There are minute distinctions however as shown in figures 37–39.

Length, 7–9 mm.

Originally described from California and recorded by Bradley from Calexico, Calif. I have before me 10 specimens from Higley and Arlington, Ariz., June 16 and July 7, mostly taken at light (A. Wetmore, and G. Holt).

GAUDII group

In Bradley's key there are three species linked with *gaudii* on the same character used in my key to groups. Of these three I have relegated *elegantula* Cockerell to another group because of the presence of only two mandibular teeth. Bradley does not make any mention of *indiscreta* Fox in his text, but on the basis of an examination of a specimen in the National Museum labeled "type" I consider this species does not belong to this group, thus we have left only two species, *petiolata* Fox, and *gaudii* Cockerell, the former of which I have not seen.

In the two species before me the gular carina is slightly outwardly deflected at its anterior extremity, the deflected part rounded in outline and widely separated from condyle of mandible. Both species have a small round tubercle in middle of clypeus and beyond that the margin is beveled off anteriorly. The propodeum is slightly roughened or sharpened and the first abdominal segment is about twice as long as its apical width. Hypopygium of *gaudii* as in *atrata* Blake.

DIAGNOSIS OF SPECIES

Black species; posterior ocelli separated from eye by a space at least 1.5 as great as their own transverse diameter; space between eye and antennal socket about as wide as socket ..... gaudii Cockerell.

Brownish orange species, the head castaneous above; posterior ocelli separated from eye by a space hardly greater than their own transverse diameter; space between eye and antennal socket about half as wide as socket.

parva, new species.

BRACHYCISTIS (BRACHYCISTIS) GAUDII Cockerell

Resembles a small specimen of *atrata* Blake, but quite different in venation of fore wing (figs. 6, 17), and in the wider space between eyes and posterior ocelli.

Originally described from La Jolla, Calif., and not seen by Bradley, who states that Professor Cockerell informed him the type is in the National Museum. I have been unable to find the type, but have before me a large series of males taken at San Diego, Calif.

BRACHYCISTIS (BRACHYCISTIS) PARVA, new species

Male.—Differs from *gaudii* Cockerell as stated in diagnosis. *B. petiolata* Blake is larger, 8 mm. in length, and has the propodeum with the sides of the dorsal surface and the postero-lateral angles rugose; the general color is rather uniformly dark castaneous. The new species has the propodeum microscopically shagreened above and along upper margins of sides.

Length, 5 mm.

Holotype.—California (C. F. Baker).

Type.—Cat. No. 27913, U.S.N.M.

I have also before me a specimen which is 7 mm. in length, agrees in color with *parva*, except that the head is black above and the body darker, and has the posterior ocelli at a little less than their transverse diameter from eyes. The propodeum is more coarsely shagreened than in *parva*, but not rugose as Bradley says is the case in *petiolata*. It is possible that this specimen represents another species, but more material is desirable before describing it.

Locality.—Arlington, Ariz., June 16, 1919 (A. Wetmore).

AMPLA group

I assign to this group besides *ampla* Blake, *protracta* Bradley. I have not seen the latter, but Bradley says they are very closely related. He makes no mention of the peculiar posteriorly narrowed head. In both species the gular carina is elevated at anterior margin and deflected outwardly at that point. Bradley's characters for distinguishing them are as follows:

Head 0.4 wider than minimum distance between the tegulae; petiole, viewed from the side, evenly but slightly enlarged posteriorly, four times as long as its dorso-ventral thickness; mandible without a carina on the upper surface at base; R_s not meeting r-m at an angle, the cell R_5 therefore triangular; color dark castaneous. Length 20 mm.....**protracta** Bradley.

Head one-tenth wider than minimum distance between the tegulae; petiole suddenly widened toward its apex, three and one-half times as long (measured along the side) as its greatest dorso-ventral thickness; each mandible with a strong carina along its upper surface, arched into a tooth near its base; R_s meeting r-m at an angle, the cell R_5 therefore four sided; color brownish-yellow. Length, 14 mm.....**ampla** (Blake).

BRACHYCISTIS (BRACHYCISTIS) AMPLA (Blake)

I have before me a number of examples of this species, some of which are about 20 mm. in length while others are about 14 mm. The petiole of the abdomen is in some of these specimens quite four times as long as its greatest dorso-ventral thickness, but the

third submarginal cell shows width narrowing above. I assume that *protracta* is a distinct species, but the characters quoted above are not to be accepted as criteria in their entirety for their differentiation.

I have seen *ampla* from Colorado, from which State it was originally described, and from Washington State.

INAEQUALIS group

Characters.—Distinguished from others by the narrow space between the eyes and the antennal sockets, which is not more than, and often considerably less than, equal to half the width of the socket. The face is much narrowed below, the space between the eyes at narrowest point being distinctly less than the distance across posterior ocelli. The space between the eyes and posterior ocelli is never appreciably greater than the transverse diameter of one ocellus, and is often distinctly less.

KEY TO SPECIES

1. Hind tibiae without pronounced dorsal bristles, sometimes with a weak one near middle; mandibles without a pronounced angle between inner tooth and base ..... 2.
   Hind tibiae with some pronounced bristles on dorsal surface extending from before middle to apex, or if these are weak or sparse the mandibles are distinctly angulate between inner tooth and base ..... 4.
2. Anterior extremities of gular carina not visible below condyle when head is seen from side; head black above; vein emanating from apical costal angle of stigma as in *inaequalis* ..... **nigrifrons**, new species.
   Anterior extremities of gular carina distinctly visible when head is seen from the side ..... 3.
3. Head dark castaneous above; vein emanting from apical costal angle of stigma bent down just after leaving latter (fig. 22) ..... **curvata**, new species.
   Head little if any darker than thorax and abdomen; vein emanating from apical costal angle of stigma running along costa for a short distance before bending down (fig. 20) ..... **inaequalis** Fox.
4. Mandible without an evident angle between base and inner tooth ..... (See *nitida* group).
   Mandible with a pronounced angle between base and inner tooth ..... 5.
5. A line drawn across the highest points of deflexed anterior parts of gular carina would pass through the mandibular condyle; hind tibiae each with one or two weak bristles about middle ..... 6.
   A line drawn across the highest points of deflexed anterior parts of gular carina would pass behind the mandibular condyles, hind tibia with quite strong dorsal bristles; head brownish orange ..... **alcanor** Blake.
6. Head black above; clypeus with a small but rather prominent tubercle in middle of anterior margin ..... [1] **dentata** Bradley.
   Head pale castaneous above; clypeus with its apical margin produced into a short transverse edge which is slightly rounded in outline, the elevated portion as wide as space between antennal sockets ..... **utahensis**, new species.

[1] The space between antennal socket and eye in this species appears to be variable in width or else there are two closely allied species present in my material. In any case I have included *dentata* in two of my keys leaving the specific status of these forms for future investigation.

BRACHYCISTIS (BRACHYCISTIS) NIGRIFRONS, new species

Male.—Shining brownish orange, frons and upper part of face glossy black.

Space between outer ocellus and eye less than that of ocellus; space between antennal socket and eye about half as wide as socket; mandibles without an angle near base; clypeus but little emarginate, the raised part not sharp and but little more elevated in center. Propodeum with dorsal part almost as long as wide, evenly and broadly rounded, without a pronounced median sulcus, the edges rounded off, posterior face and upper margins of sides with setiferous punctures. First segment of abdomen twice as long as high, and about 1.5 as long as its apical width. Two or three of the dorsal hairs on hind tibia strong but not conspicuously so. Venation as in *inaequa lis*.

Length, 9–10 mm.

Type and one paratype.—Graham Mountains, Ariz., Ash Creek, 3,200 feet, June 15, 1914 (E. G. Holt).

Type and paratype.—Cat. No. 27921, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) INAEQUALIS Fox

This species has the hypopygium similar to that of *atrata* Blake. The marginal cell of fore wing is as in figure 20. When the head is viewed from the side the apex of the anterior elevation of the gular carina is quite clearly visible below the level of the mandibular condyle and almost in line with it. The clypeus is broadly and evenly emarginate in center, the margin of the central part being very little elevated and without a central tubercle; the space between eye and antennal socket is very narrow, that between eye and posterior ocelli a little narrower than transverse diameter of the ocellus. Propodeum broad, evenly rounded, and with rather coarse setiferous punctures posteriorly, laterally. Basal segment of abdomen about 1.25 as long as its apical width.

Length, 10–12 mm.

Originally described from Los Angeles, Calif., from which locality I have many specimens before me. I have also some from Texas.

BRACHYCISTIS (BRACHYCISTIS) CURVATA, new species

Male.—Differs from *inaequalis* as stated in key and as follows: More slender; propodeum with a broad shallow sulcus on anterior part of dorsum in center; first abdominal segment about 1.5 as long as its apical width.

Length, 10 mm.

Holotype.—Arizona (C. F. Baker). Paratype, Fort Mohave, Ariz. (Junius Henderson).

Type and paratype.—Cat. No. 27919, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) DENTATA Bradley

Male.—Head dark castaneous, almost black above; thorax and abdomen brownish orange; stigma dark brown.

Space between eye and posterior ocelli about equal to transverse diameter of either ocellus and to space between posterior ocelli and anterior ocellus; a slight transverse ridge above each antennal insertion; space between edge and antennal socket almost linear; clypeus with a rather beaklike tubercle on its lower margin in middle, beyond which the edge is abruptly beveled, the submedian angles not noticeably toothlike; mandibles stout, the upper edge sharp and rather conspicuously angled near base; gular carina much as in *inaequalis*. Propodeum finely shagreened dorsally and with or without central sulcus, the sides above and posterior surface with setiferous punctures. First segment of abdomen fully as long as its apical width. Hind tibial bristles not conspicuous, and sparse.

Length, 8 mm.

Locality.—Flagstaff, Santa Rita Mountains, and Fort Grant, Ariz., Mesilla and Lordsbury, N. Mex.: Colorado, and San Bernardino, Calif.

Originally described from New Mexico.

BRACHYCISTIS (BRACHYCISTIS) UTAHENSIS, new species

Male.—Very similar to the preceding species, differing as stated in the key. The sulcus on propodeum is more distinct than in the last species the basal abdominal segment shorter, and the size greater.

Length, 10 mm.

Holotype.—Utah (C. F. Baker).

Type.—Cat. No. 27920, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) ALCANOR Blake

If my interpretation of this species is correct it varies considerably in size, intensity of puncturation, size of ocelli, and some other characters. It is possible, however, that a careful scrutiny of more material from the various localities listed below will prove that there is more than one species in the lot now before me, which fact I can not demonstrate satisfactorily at this time.

Length, 7–15 mm.

Originally described from Arizona. Specimens in the collections here are from Arizona, and Los Angeles County, Calif.

MICROMMATA group

Characters.—Distinguished by the small size of the ocelli, the posterior pair being separated from the eyes by a distance almost or quite twice as great as the transverse diameter of one ocellus.

I have not seen *micrommata* Bradley, but use the characters given by Bradley for distinguishing it from the new species in the following diagnosis.

KEY TO SPECIES

1. Black species; clypeus with a raised marginal point; carina extending from inner tooth to base of mandible strongly, but not angularly, elevated near base ..... **micrommata** Bradley.
   Brownish-orange species ..... 2.
2. Head concolorous with thorax, brownish-orange; mandible with a carina from inner tooth to base which is not appreciably elevated near base ..... 3.
   Head black, contrasting with the brownish-orange thorax; mandible with a carina from inner tooth to base which is prominently elevated near base .. 4.
3. Clypeus with a short thin transverse elevation or lip in center of apical margin, the edge very narrowly and steeply beveled beyond it; anterior elevation of gular carina in line with mandibular condyle, close to it and deflexed ..... **intermedia**, new species.
   Clypeus with a vertical rounded elevation in middle, the apical edge narrowly beveled; anterior elevation of gular carina behind mandibular condyle, remote from it, and deflexed ..... **verticalis**, new species.
4. Propodeum smooth above; extreme height of first abdominal segment as seen from the side less than half as great as length of segment along lateral suture ..... **melanocephala**, new species.
   Propodeum finely striate on each side on dorsum; extreme height of first abdominal segment over half as great as length of segment along lateral suture ..... **dakotensis**, new species

BRACHYCISTIS (BRACHYCISTIS) MICROMMATA Bradley

Bradley's synoptic description of the color, etc., of this species is as follows: Black, the tarsi and antennæ brown, the latter dark except at base; sparsely clothed with somewhat yellowish pile; wings hyaline, slightly infuscated beyond stigma, which is piceous; veins brownish-yellow to piceous.

Length, 8 mm., slender.

The head of this species must differ in many details from that of *melanocephala*, as indicated by the characters here taken from the original description. Measurements of ocelli, etc.: Posterior ocellus, diameter, 0.17 mm.; distance of posterior ocellus from eye, 0.3; distance between posterior ocelli, 0.38 mm.; inferior margin of antennal socket thickened, with a downward projecting triangular tubercle. The clypeus and mandibles are apparently similar to those of *melanocephala* but no mention is made of the structure of the gular carina. The venation of the fore wing as figured by Bradley is the same as that of *melanocephala*.

Originally described from Berkeley, Calif. Type in Cornell University.

BRACHYCISTIS (BRACHYCISTIS) INTERMEDIA, new species

Male.—Brownish-orange. Tips of mandibles castaneous. Stigma fuscous.

Head above similar to that of *texana;* space between posterior ocelli and eye about twice as wide as transverse diameter of either ocellus; space between eye and antennal socket equal to socket;

gular carina with a prominent elevation near anterior extremity on each side, which is deflexed to sides, plainly visible below condyle when head is seen from side, and almost in line with condyle. Propodeum rather stout, with a sulcus in middle anteriorly, the posterior and upper lateral parts with numerous setiferous punctures. First abdominal segment at most 1.5 as long as its apical width. Marginal cell of fore wing as in figure 24.

Length, 7–9 mm.

Holotype and 12 paratypes.—San Diego, Calif. (Ricksecker).

Type and paratypes.—Cat. No. 27922, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) VERTICALIS, new species

Male.—Colored as *intermedia.*

Space between posterior ocelli and eye not much over 1.5 as great as width of either ocellus, and twice as wide as space between anterior and posterior ocelli. Space between eye and antennal socket as wide as socket; clypeus convex, centrally elevated in the form of a rounded vertical carina, the edge narrowly beveled on emarginate central portion, the submedian angles not prominent; mandibles without an angle between inner tooth and base; gular carina quite conspicuously and sharply elevated on each side at a little distance behind the transverse line of the mandubilar condyles, the gular orifice at its anterior margin hardly wider than the space between it and either eye. Pronotum not depressed and abruptly declivous in front, rather evenly rounded; mesopleura glossy, with large punctures; propodeum short and stout, with a shallow dorsal sulcus, the sides above and posterior surface rather coarsely punctured. First abdominal segment not longer than its apical width. Hind tibia with quite conspicuous dorsal bristles. Vein bounding costal margin of marginal cell bent down close to stigma. Anterior cross-vein of hind wing (R_4) erect, not shorter than R_s

Length, 10 mm.

Holotype.—Fort Grant, Ariz., July 19 (Hubbard).

Type.—Cat. No. 27923, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) MELANOCEPHALA, new species

Male.—Head black, mandibles, antennae, and palpi, brownish orange, clypeus darker. Thorax, abdomen, and legs brownish orange, abdomen dark brown apically. Wings clear, veins yellow, stigma brown.

Frons when seen from side projecting above the upper level of eye distinctly more than height of ocellus exclusive of latter; space between antennal socket and eye a little greater than width of socket; the latter without a noticeable thickening below, not tuberculate; clypeus as in figure 33; mandible with a sharp ridge extending from inner tooth to base, which is rather angularly produced near base; gular carina elevated in line with condyle at base of mandible,

visible above latter when head is seen from side, the elevated portion not horizontal but beveled off internally so that when it is seen from below it presents a flattened surface with a ridge along its outer side which is directed obliquely laterad; posterior ocellus half as wide as space between it and anterior ocellus; distance between posterior ocelli and that between either and eye subequal. Propodeum smooth and evenly rounded above, posteriorly and on sides above with some setigerous punctures. Basal abdominal segment about one-fifth as long as its apical width, distinctly constricted from second. Second and third submarginal cells subequal, both combined about as long as greatest length of first.

Length, 8 mm.

Holotype.—Currant Creek, 8,000 feet, Uinta National Forest, Utah, August 13, 1917 (J. Silver).

Type.—Cat. No. 27924, U.S.N.M.

There is a specimen from Fort Grant, Arizona, in the National Museum which may represent another species. It has the posterior ocelli a little nearer to eyes and might be considered as belonging to the *nitida* group.

BRACHYCISTIS (BRACHYCISTIS) DAKOTENSIS, new species

Male.—Similar to preceding species, but stouter and darker colored besides differing as stated in the key.

Length, 9 mm.

Holotype.—Edgemont, S. Dak., August 6, 1915 (E. G. Holt).

Type.—Cat. No. 27925, U.S.N.M.

NITIDA group

In this group the gular carina is not elevated and flexed outward at or near its anterior extremities, its anterior extremities never being visible below the mandibular condyle when the head is viewed directly from the side; and the vein emanating from apical costal angle of stigma extends along costa at least as far as length of crossvein emanating from stigma.

KEY TO SPECIES

1. Gular orifice at its anterior margin hardly wider than space between anterior extremities of gular carina and eye, first abdominal segment over twice as long as its apical width; clypeus with a central tubercle or production, beyond which it is beveled to edge ..... **nitida** (Cresson).
   Gular orifice at its anterior margin much wider than space between anterior extremities of gular carina and eye; first abdominal segment not nearly twice as long as its apical width ..... 2.
2. Clypeus with a distinct central beveled emargination and a slight raised point above it in middle ..... **washingtona**, new species.
   Clypeus with an elevated sharp transverse apical tip beyond which there is no beveled edge ..... 3.
3. First abdominal segment not much more than half as wide at apex as it is long ..... **nevadensis** Fox.
   First abdominal segment nearly as wide at apex as it is long ..... **glabrella** Cresson.

BRACHYCISTIS (BRACHYCISTIS) NITIDA (Cresson)

This is a rather distinct species, distinguished from its allies by the narrow gular orifice, and elongated first abdominal segment. The space between eye and posterior ocelli is distinctly narrower than the transverse diameter of either ocellus, the head is yellow, forehead with sparse minute punctures; space between eye and antennal socket about as wide as socket; clypeus bevelled in the space between edge and central elevation, the submedian angles prominent but not toothed; gular carina erect to anterior extremities; mandibles stout, curved, sharp edged above on apical half but without a noticeable angle basally. Propodeum rather elongate, rounded above, and with a more or less evident central sulcus. Hind tibia with quite pronounced dorsal bristles, which are set on slightly elevated bases. Marginal cell as in *inaequalis* Fox.

Length, 11–14 mm.

There is a paratype from Colorado in the United States National Museum.

Paratype.—Cat. No. 1667, U.S.N.M.

In addition to this I have before me specimens from Colorado, New Mexico, and Lincoln, Nebr. Bradley records it also from Arizona.

BRACHYCISTIS (BRACHYCISTIS) WASHINGTONA, new species

Male.—Brownish-orange, upper half of head, tips of mandibles, and stigma blackish.

Posterior ocelli about 1.5 as wide as space between either and eye, the distance between anterior and posterior ocelli a little over half as wide as that between posterior ocelli and eye; usually two or four elevated points above antennal insertions; clypeus with a rounded central emargination above the middle of the beveled edge of which there is a small raised point, the rim on which it is situated quite rounded; gular carina slightly flared to side anteriorly, widely separated from condyle. Propodeum stout, with setiferous punctures on posterior side and on upper part of sides. Basal segment of abdomen about two-thirds as wide at apex as long on sides. Marginal cell similar to that of *inaequalis* Fox. Hind tibia with or without one or two dorsal bristles.

Length, 12–13 mm.

Holotype and three paratypes.—Ritzville, Wash., August, 1920 (R. C. Shannon).

Type and paratypes.—Cat. No. 27926, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) NEVADENSIS Fox

A specimen which runs to this species in Bradley's key is very difficult to distinguish from those I consider are *glabrella* Cresson. In fact the only character upon which it is separable, the comparative

length and width of the first abdominal segment is rather a variable and unreliable one in this group.

Originally described from Nevada. The specimen I assign here is from Luna, N. Mex., June, 1916 (J. G. Crick).

BRACHYCISTIS (BRACHYCISTIS) GLABRELLA Cresson

Originally described from Colorado. I have specimens evidently belonging to this species from Arizona, Texas, New Mexico, Colorado, and South Dakota.

One specimen from Texas is only 7 mm. in length; the average length of the series is over 10 mm.

ATRATA group

Characters.—This group has the gular carina elevated and deflected at or near the anterior extremities, the highest points visible below the mandibular condyle when the head is viewed directly from the side, or if the elevation is barely or not visible the vein emanating from the apical costal angle of the stigma turns downward at less than the length of the cross vein emanating from hind side of the stigma from apex of latter.

KEY TO SPECIES

1. Gular carina very low, not elevated at anterior extremities, not visible below condyle from side, distance from anterior extremity to condyle about half as great as anterior width of gular orifice; mandible distinctly angulate near base; propodeum rounded, microscopically shagreened dorsally, and with very faint sulcate line from anterior margin; the vein emanating from apical costal margin of stigma bent downward at base....**imitans**, new species.
   Gular carina more or less distinctly elevated and outwardly deflected at or near anterior extremities, frequently visible below condyle when head is seen from the side, and not so far distant from condyle.....2.
2. At least the head and thorax shining black.....3.
   Thorax brownish orange or castaneous, head sometimes black above....5.
3. Central tubercle on clypeus very prominent; anterior extremities of gular carina vertical, not flared outward, distant from mandibular condyle by three or four times the width of apical segment of maxillary palpus; vein emitted from apical costal angle of stigma paralleling costa for a short distance before bending downward; propodeum granulose or rugose at the edge of the rather vertical posterior portion, dorsum with a quite pronounced median longitudinal sulcus.....**lacustris**, new species.
   Central tubercle on clypeus poorly developed; anterior extremities of gular carina flared outward, usually quite distinctly visible from side.....4.
4. Dorsal surface of propodeum entirely, or for the greater part, obviously shagreened, and not highly polished; abdomen more brown or reddish-brown than black; frons in front of ocelli with scattered punctures, no large one in front of anterior ocellus.....**semiatra**, new species.
   Dorsal surface of propodeum highly polished and smooth except for the faint median longitudinal sulcus; abdomen normally entirely black; frons in front of ocelli polished, almost impunctate except for a large, deep pit or puncture just in front of anterior ocellus.....**atrata** (Blake.)

5. Posterior ocelli separated from eye by at least 1.5 as great a distance as the transverse diameter of either ocellus.....(see *micrommata* group.)
   Posterior ocelli separated from eye by much less than 1.5 as great a distance as transverse diameter of either ocellus.....6.
6. Anterior elevations of gular carina large, a line drawn across their highest points would pass distinctly behind the mandibular condyles; small brownish-orange species with black head.....**indiscreta** Fox.
   Anterior elevations of gular carina moderate in height, a line drawn transversely across their highest points would pass over the mandibular condyles, sometimes beyond their highest points.....7.
7. Space between antennal socket and eye not over half as wide as socket .....(see *inaequalis* group.[2])
   Space between antennal socket and eye well over half as wide as socket....8.
8. Propodeum short and broad, the horizontal anterior part broader than long, rather sharply marked off from the precipitous posterior portion and the sides; basal segment of abdomen seen from the side of its highest part about two-thirds as high as its length on lateral suture; an arcuate frontal carina over each antenna; head brownish orange....**triangularis** Cresson.
   Propodeum longer, sloping downward from about middle; basal segment of abdomen seen from the side not half as high as long; no arcuate frontal carinae over antennae; head black or fuscous, much darker than thorax .....**dentata** Bradley.

BRACHYCISTIS (BRACHYCISTIS) IMITANS, new species

Male.—Head black, mandibles and antennae brownish orange. Thorax dark castaneous, paler on sides of prothorax and of mesonotum, the tegulae brownish-yellow. Abdomen castaneous, blackish apically. Tip brownish yellow, stigma fuscous.

Posterior ocelli at distinctly less than their transverse diameter from eye; space between eye and antennal socket a little narrower than socket; clypeus hardly elevated in center, the edge but little bevelled; carina from inner tooth to base complete and sharp, with a distinct angle near base; gular carina not obviously deflexed outwardly at apex, distant from edge about two-thirds of width of gular orifice. Mesopleura distinctly punctate; propodeum not as elongate as in *atrata*, the hind margin more abruptly declivous, surface not polished above but closely shagreened, the hind margin and upper part of sides with many setiferous punctures. First abdominal segment over 1.5 as long as its apical width, marginal cell as in Figure 23. Hind tibia without pronounced dorsal bristles.

Length, 7 mm.

Holotype.—Los Angeles County, Calif., September (D. W. Coquillett).

Type.—Cat. No. 27927, U.S.N.M.

BRACHYCISTIS (BRACHYCISTIS) ATRATA (Blake)

This species as I interpret it is usually shining black in color, with the lower half of face, tibiae, and tarsi, and usually the pro-

[2] For description see under *inaequalis* group.

pleurae brownish-orange, though the pale color may be more or less extensive in individual specimens. The characters listed in the key may be amplified as follows: The propodeum is glossy above, usually without shagreening, and sometimes with a shallow median sulcus; the mandibles have no evident angle near base; the first abdominal segment is fully twice as long as its apical width; and the vein emanating from apical costal angle is curved downward almost immediately after leaving the stigma. Hypopygium as in Figure 53.

Length, 8–10 mm.

Originally described from Nevada and recorded from California. I have before me specimens from California and Nevada. One of the California specimens bears the name *nigritus* Fox (determined by Fox), and another *contiguus* Fox (determined by Ashmead). Bradley has suggested that *nuda* Fox, which he says is the same as *nigritus*, is not specifically distinct from *atrata*, of which he considers *contiguus* a synonym. I consider the names all apply to *atrata*, if the specimens before me are correctly identified.

BRACHYCISTIS (BRACHYCISTIS) LACUSTRIS, new species

Male.—Similar to *atrata* in color, differing essentially as stated in the foregoing key to species. In addition to these characters the frons in front of ocelli is more distinctly punctate, the pit in front of median ocellus is larger and broader, not like a single puncture, the antennae are brownish orange, and the basal segment of abdomen is shorter and higher as seen from the side. In other respects the species resemble each other.

Length, 9 mm.

Type.—Cat. No. 27928, U.S.N.M. Sutcliffe Station, Pyramid Lake, Nev., May 27, 1924, in alfalfa field (C. R. Hall).

BRACHYCISTIS (BRACHYCISTIS) SEMIATRA, new species

Male.—Readily distinguished from *atrata* by the reddish brown color of basal portion of dorsum of abdomen and by the characters given in the key to species. In other respects the species are very similar.

Length, 8–11 mm.

Type and 6 paratypes.—Ritzville, Wash., June to August, 1923 (M. C. Lane and R. C. Shannon); type collected August 28, 1923, by M. C. Lane; one paratype, Pasco, Wash., September 11, 1904, at light.

Type and paratype.—Cat. No. 27929, U. S. N. M.

Two specimens from Pyramid Lake, Nev., may belong to this species but are rather smaller and more uniform brownish fuscous in color.

BRACHYCISTIS (BRACHYCISTIS) TRIANGULARIS Cresson

I identify as this species specimens from Hot Springs and Higley, Ariz., and Lordsburg, N. Mex.

Originally described from Arizona.

BRACHYCISTIS (BRACHYCISTIS) INDISCRETA Fox

I have before me a specimen from Wilcox, Ariz., which agrees with specimens, evidently from the type material, in the United States National Museum.

Bradley includes this species in his key but omits it in the treatment of the species.

BRACHYCISTIS (BRACHYCISTINA), new subgenus

This subgenus is distinguished from the other two by the presence of only one preapical mandibular tooth which is sometimes poorly developed.

Genotype.—*Brachycistis* (*Brachycistina*) *acuta*, new species.

There are two species referable here which may be distinguished as indicated below.

KEY TO SPECIES

Preapical tooth of mandibles poorly developed, an angle, apical tooth long and sharp (fig. 26); posterior ocelli separated from eye and from anterior ocellus by about twice as great a distance as their transverse diameter . . acuta, new species.

Preapical tooth of mandibles well developed, apical tooth short and stout (fig. 25); posterior ocelli separated from eye and from anterior ocellus by about as great a distance as their own diameter . . . . . elegantula (Cockerell and Casad).

BRACHYCISTIS (BRACHYCISTINA) ACUTA, new species

Male.—Pale brownish-orange, head fuscous above, tips of mandibles blackish; stigma pale-brown. Head subquadrate above; ocelli rather small; clypeus as in Figure 27, descending farther than in any other species known to me, the apex transverse, not bevelled and without submedian teeth, the central part with a rounded elevation which slopes evenly off on sides and below; gular orifice not over one-third wider than space between it and eye at anterior extremity, the carina low, not bevelled at anterior extremity; vertex with very few punctures. Propodeum short and robust, without distinct sculpture. Basal abdominal segment about as long as its apical width; hypopygium as in Figures 54 and 55. Hind tibia with two or three short bristles showing amongst the hairs; hind coxae not carinate. Fore wing in type with but two submarginal cells, the cross vein from stigma interstitial with vein closing second submarginal, the latter cell a little over half as long as first.

Length, 6 mm.

Holotype.—Arlington, Ariz. June 17, 1919 (A. Wetmore).

Type.—Cat. No. 27930, U.S.N.M.

Genitalia and apical segments of abdomen in vial with alcohol.

BRACHYCISTIS (BRACHYCISTINA) ELEGANTULA (Cockerell and Casad)

Differs from preceding species as noted in key and also in the following particulars. The clypeus has a more prominent central elevation, the apical central portion is not so much produced downward and in addition the margin is bevelled, with a short but noticeable tooth on each angle of the produced central part. The basal segment of abdomen is distinctly longer than its apical width, and the hypopygium is similar to that of *atrata* Blake. There are three submarginal cells in the fore wing of all four specimens before me, including one labeled "type," the cross vein from stigma being well before the vein closing third submarginal cell (fig. 5).

Length, 6–8 mm.

Originally described from Mesilla Park, N. Mex. I have seen a specimen from Chiricuhua Mountains, Arizona.

Type.—Cat. No. 2593, U.S.N.M.

EXPLANATION OF PLATES

PLATE 1

Details of Brachycistiinae, Psammocharidae, and Cyphotinae

FIG. 1. *Brachycistis carinata*, prothorax of male from side.
1*a*. *Ceropales texanus*, same.
2. *Brachycistis atrata*, seventh and eighth abdominal sternites of male from below.
3. *Brachycistis atrata*, apex of abdomen of male from side, expanded to show hypopygium, etc.
4. *Brachycistis amplus*, fore wing of male.
5. *Brachycistina elegantulus*, same.
6. *Brachycistis gaudii*, same.
7. *Brachycistis carinata*, hind wing of male.
8. *Brachycistis washingtona*, apex of radius of hind wing, male.
9. *Brachycistis carinata*, same.
10. *Cyphotes*, species, same.
11. *Mrymosa unicolor*, same.
12. *Myrmosa unicolor*, cerci of male.
13. *Cyphotes melaniceps*, same.
14. *Typhoctes mirabilis*, side view of thorax of female. *P*=prothorax, *Me*=mesothorax, *Mt*=metathorax and propodeum, *A*=abdomen, *1*, *2*, *3*, fore, mid, and hind coxae.
15. *Cyphotes melaniceps*, base of abdomen of male.
16. *Cyphotes* species, same, female.

PLATE 2

Structural characters of *Brachycistis* males

FIG. 17. *Brachycistis gaudii*, stigma and adjoining cells of fore wing.
18. *Brachycistis stygia*, same.
19. *Brachycistis texana*, same.
20. *Brachycistis inaequalis*, same.
21. *Brachycistis noctivaga*, same.
22. *Brachycistis curvata*, same.
23. *Brachycistis imitans*, same.
24. *Brachycistis intermedia*, same.
25. *Brachycistina elegantula*, mandible.
26. *Brachycistina acuta*, same.
27. *Brachycistina acuta*, clypeus from front.
28. *Brachycistis normalis*, one side of carina of gular orifice.
29. *Brachycistis aequalis*, same.
30. *Brachycistis noctivaga*, same.
31. *Brachycistis indiscreta*, same.
32. *Brachycistis texana*, same.
33. *Brachycistis melanocephala*, apex of clypeus from front.
34. *Brachycistis texana*, head from above.
35. *Brachycistis ampla*, same.
36. *Brachycistis eremi*, apex of hypopygial volsella and sagitta.
37. *Brachycistis brevis*, same.
38. *Brachycistis brevis*, uncus from side.
39. *Brachycistis brevis*, uncus from above.
40 *Brachycistis ampla*, hypopygium from side.
41. *Brachycistis thermarum*, same.
42. *Brachycistis stygia*, same.

PLATE 3

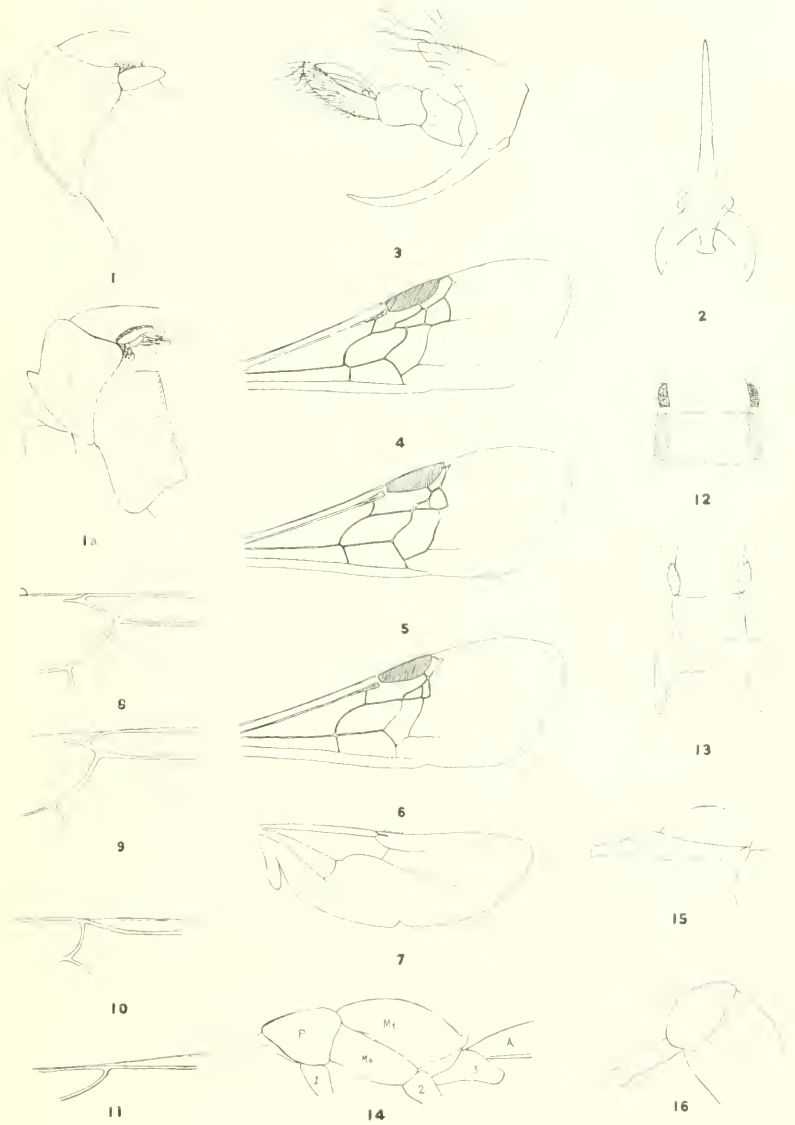
Hypopygia of *Brachycistis* males

FIG. 43. *Brachycistis normalis*, left side dorsal, right ventral.
44. *Brachycistis crassa*, side view.
45. *Brachycistis crassa*, left side ventral right dorsal with dorsal and lateral views of apex of.
46. *Brachycistis stygia*, left side dorsal, right ventral *a*. *b*. and *c* show characters of *castanea*.
47. *Brachycistis thermarum* same.
48. *Brachycistis carinata*, same.
49. *Brachycistis texana*, same.
50. *Brachycistis eremi*, same.
51. *Brachycistis alcanor*, same.

PLATE 4

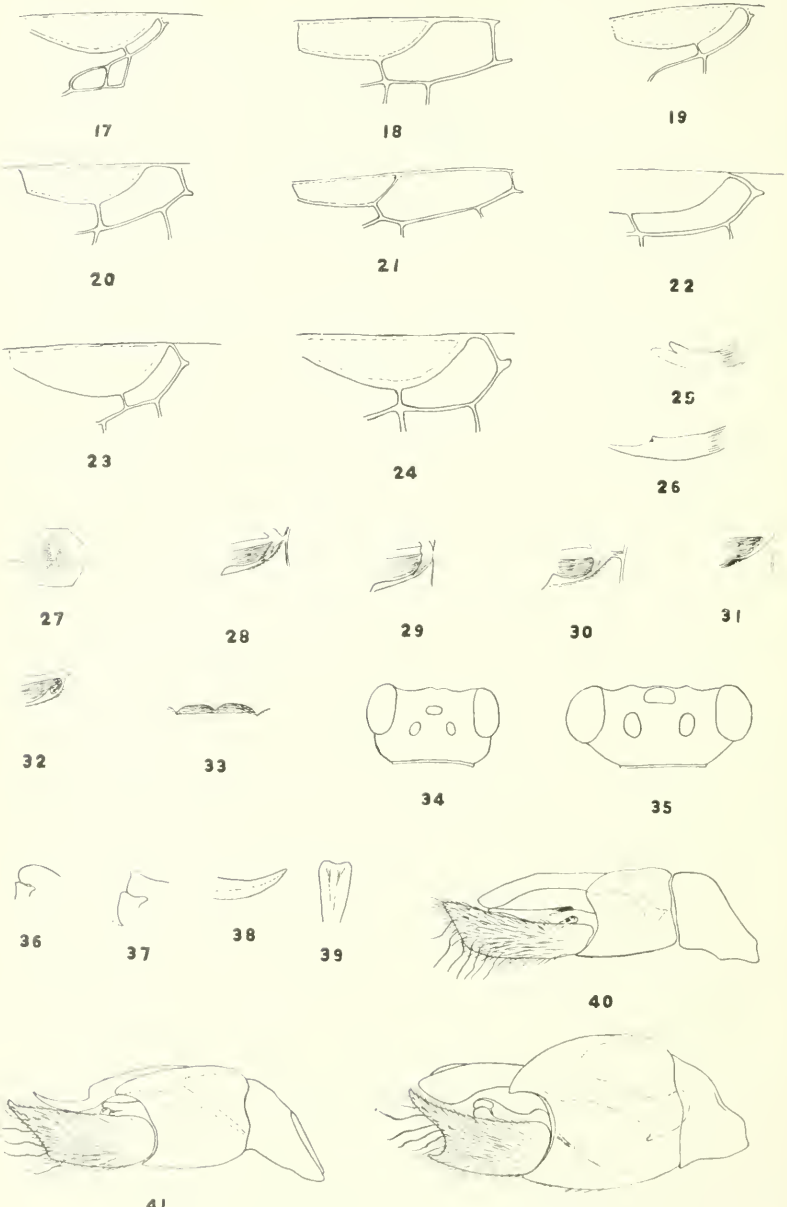
Hypopygial characters of *Brachycistis*, *Cyphotes*, and *Myrmosa* males

FIG. 52. *Brachycistis ampla*, hypopygium, left side dorsal, left ventral.
53. *Brachycistis atrata*, same.
54. *Brachycistina acuta*, hypopygium, side view.
55. *Brachycistina acuta*, same, dorsal view, one half.
56. *Brachycistellus inermis*, same.
57. *Brachycistellus inermis*, same, side view.
58. *Cyphotes melaniceps*, same.
59. *Cyphotes melaniceps*, same, left side ventral view, right side dorsal.
60. *Cyphotes melaniceps*, seventh and eighth ventral segments of abdomen from below.
61. *Myrmosa unicolor*, hypopygium, left side ventral view, right side dorsal.
62. *Myrmosa unicolor*, 7th and 8th ventral segments of abdomen from below.



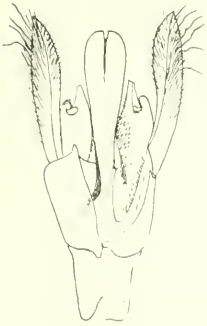
DETAILS OF BRACHYCISTIINAE, PSAMMOCHARIDAE, AND CYPHOTINAE

FOR EXPLANATION OF PLATE SEE PAGE 26



STRUCTURAL CHARACTERS OF BRACHYCISTIS MALES

FOR EXPLANATION OF PLATE SEE PAGE 27



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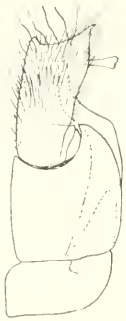

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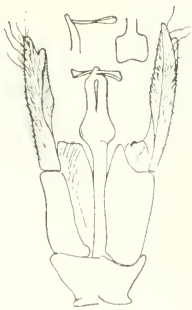

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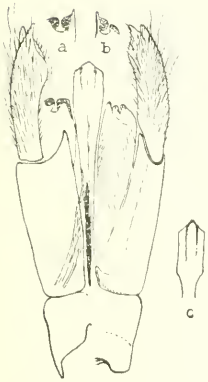

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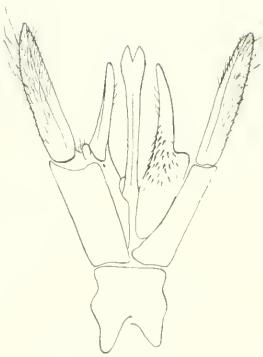

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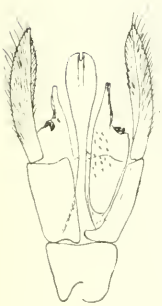

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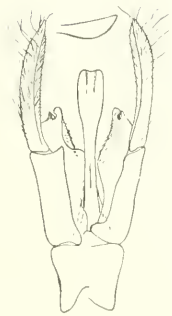

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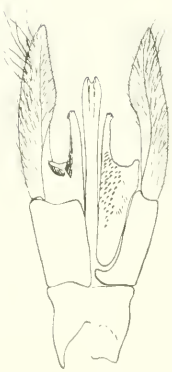

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HYPOPYGIA OF BRACHYCISTIS MALES

FOR EXPLANATION OF PLATE SEE PAGE 27

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HYPOPYGIAL CHARACTERS OF BRACHYCISTIS, CYPHOTES, AND MYRMOSA MALES

FOR EXPLANATION OF PLATE SEE PAGE 28

CRANE FLIES FROM THE MARITIME PROVINCE OF SIBERIA

By Charles P. Alexander

Of the Massachusetts Agricultural College, Amherst

The crane flies that were taken by Prof. T. D. A. and Mrs. Cockerell on their recent trip to Eastern Siberia have been submitted to me for determination. Because of the almost total lack of material and records from this region, the collection proved to be of exceptional interest and furnished several important additions to the incomplete list of the Tipuloidea of Eastern Siberia. In addition to the species recorded in the following pages, Professor Cockerell writes me that he saw, but was unable to capture, a specimen of *Ctenacroscelis mikado* (Westwood) at Tsuruga, Japan. My sincere thanks are extended to Professor and Mrs. Cockerell, and to the National Museum authorities, for the privilege of studying this series of Tipulidae. The types and specimens of all other included species are preserved in the National Collection.

In order that the known and probable components of the Tipulid fauna of Eastern Siberia may be more correctly understood, the following list of *Regional Species* is supplied. In addition, it may be well to indicate the occurrence of the European *Dictenidia bimaculata* (Linnaeus) in this coastal province of Siberia, an enormous extension of the range of the species, which, however, has never been taken in Japan.

REGIONAL SPECIES

Almost the only Siberian Tipulidae that may be considered as being regional are the following: *Tipula breviceps* (Motschulsky)[1] from Amurland and few Tipuline crane flies belonging to the subtribe Ctenophoraria, described in 1873 and 1887 by Portschinsky (*Ctenophora parva* Portschinsky, *C. pictipennis* Portschinsky, *Tanyptera gracilis* (Portschinsky), *T. minuta* (Portschinsky), and *T. siberica* (Portschinsky), all from various parts of Siberia, some from the vicinity of Vladivostock.

[1] *Tipulina breviceps* Motschulsky, Bull. Soc. Imp. Nat. Moscou, vol. 32, p. 503, 1859.

The Tipulidae of the island of Saghalien, separated from the Coast Province of Eastern Siberia only by the narrow Gulf of Tartary, show notable affinities with the mainland. The following Tipulidae taken in Siberia by Professor and Mrs. Cockerell on their trip are also known from Japanese Saghalien (Karafuto): *Limonia karafutonis* Alexander, *Dicranomyia immodestoides* Alexander, *D. spinicauda* Alexander, *Rhipidia maculata* Meigen, *R. pulchra septentrionis* Alexander, *Limnophila nemoralis* (Meigen), variety, *Helobia hybrida* (Meigen), *Tipula latemarginata* Alexander, and *T. bubo* Alexander. This constitutes nearly one-half of all the nonendemic species taken, but it should be noted that all of the species listed have a wide range, either southward through the Japanese islands, throughout the Palaearctic Region, or, in the cases of *Rhipidia maculata* and *Helobia*, occurring throughout the Holarctic Region. The following Tipulidae known from Karafuto occur in Eastern Siberia or are regional:

Discobola margarita Alexander.
D. argus (Say).
Dicranomyia immodestoides Alexander.
D. megacauda Alexander.
D. mesosternata Alexander.
D. sachalina Alexander.
D. sparsa Alexander.
D. spinicauda Alexander.
Limonia episema Alexander.
L. karafutonis Alexander.
L. plutonis Alexander.
L. subnubeculosa Alexander.
Geranomyia avocetta Alexander.
Rhipidia maculata Meigen.
R. pulchra septentrionis Alexander.
Dicranoptycha venosa Alexander.
Limnophila japonica Alexander.
L. nemoralis (Meigen), variety.
L. sapporensis Alexander.
L. subadusta Alexander.
L. subpoetica Alexander.
L. unicoides Alexander.
Pilaria dorsalis Alexander.
Eriocera sachalinensis Alexander.
Polyangaeus gloriosus Alexander.
Rhaphidolabina gibbera Alexander.
Rhaphidolabis flavibasis Alexander.
Neolimnophila ultima Osten Sacken, variety.
Gnophomyia tristis Alexander.
Gonomyia (*Ptilostena*) *sachalinensis* Alexander.
Helobia hybrida (Meigen).
Cheilotrichia imbuta (Meigen).
Ormosia subdeviata Alexander.
Molophilus albibasis Alexander.
Erioptera (*Erioptera*) *horii* Alexander.
E. (*E.*) *flavohumeralis* Alexander.
E. (*E.*) *xanthoptera* Alexander.
E. (*Acyphona*) *sachalina* Alexander.
E. (*Hoplolabis*) *asiatica* Alexander.
Oropeza satsuma Alexander.
Ctenophora biguttata Matsumura.
Tanyptera jozana Matsumura, variety. (Probably includes *macra* Matsumura, not Loew.)
Tipula bubo Alexander.
T. bipenicilleata Alexander.
T. coquilletti Enderlein.
T. coquillettiana Alexander.
T. flavocostalis Alexander.
T. insulicola fuscicauda Alexander.
T. nipponensis Alexander.
T. latemarginata Alexander.
T. tantula Alexander.
T. verecunda Alexander.
T. variicornis Schummel.
T. westwoodiana Alexander.
Nephrotoma aculeata atricauda Alexander.
N. dorsalis sachalina Alexander.
N. hirsuticauda Alexander.
N. lamellata (Riedel), variety.
N. minuticornis Alexander.
N. saghaliensis Alexander.

The Ptychopterid, *Ptychoptera subscutellaris* Alexander, likewise occurs.

Matsumura[2] described two new species and a supposedly new genus from Sakhalin. His *Limnobia sachalinensis* would appear to be a species of *Limnophila*, or at least Hexatomine. The new genus *Metalimnobia* (for *vittata*, new) is certainly close to *Limonia* in the venation and nature of the claws. Neither of the above species have been recognized since their original characterization.

The island of Hokkaido (Yezo), the most northerly of the four chief islands of Japan, is separated from Sakhalin only by the narrow La Perouse Strait and from the southern end of the Coast Province of Siberia by the relatively narrow northern portion of the Japan Sea. The Tipulid fauna shows a characteristic Holarctic facies. The following crane flies are now known from Hokkaido and several will certainly be found to occur also in Eastern Siberia.

Discobola argus (Say).
D. margarita Alexander.
D. moiwana Alexander.
Dicranomyia globulithorax Alexander.
D. immodestoides Alexander.
D. longipennis (Schummel).
D. mesosternata Alexander.
D. spinicauda Alexander.
D. subtristis Alexander.
Limonia amabilis Alexander.
L. angustistria Alexander.
L. annulus truncata Alexander.
L. basispina Alexander.
L. bifasciata avis Alexander.
L. crinita Alexander.
L. fusciceps Alexander.
L. inelegans Alexander.
L. machidai (Alexander).
L. mendax Alexander.
L. monacantha Alexander.
L. neoindigena Alexander.
L. neonebulosa Alexander.
L. nigronitida Alexander.
L. quadrinotata (Meigen).
Libnotes longistigma Alexander.
L. nohirai Alexander.
Rhipidia maculata Meigen.
R. pulchra septentrionis Alexander.
Elliptera zipanguensis Alexander.
Helius tenuirostris Alexander.
Dicranoptycha venosa Alexander.
Antocha (*Proantocha*) *serricauda* Alexander.
A. (*Antocha*) *bifida* Alexander.
A. (*A.*) *brevinervis* Alexander.
A. (*A.*) *brevistyla* Alexander.
A. (*A.*) *dilatata* Alexander.
A. (*A.*) *satsuma* Alexander.
Ula perclegans Alexander.
U. cincta Alexander.
Epiphragma subfascipennis Alexander.
E. subinsignis Alexander.
Limnophila inconcussa Alexander.
L. japonica Alexander.
L. kuwayamai Alexander.
L. melanommata Alexander.
L. neomunda Alexander.
L. unicoides Alexander.
Pilaria dorsalis Alexander.
Eriocera fulvibasis Alexander.
E. jozana Alexander.
Elephantomyia hokkaidensis Alexander.
Pedicia daimio (Matsumura).
Dicranota yezoensis Alexander.
Rhaphidolabis subconsors Alexander.
Conosia irrorata (Wiedemann).
Chionea, sp.
Paratropesa esakii Alexander.
Teucholabis yezoensis Alexander.
Gonomyia (*Ptilostena*) *subpruinosa* Alexander.
G. (*Gonomyia*) *superba* Alexander.

[2] Erster Beitrag zur Insekten-Fauna von Sachalin, Journ. Coll. Agric. Tohoku Imper. Univ., vol. 4, pp. 1–45, 1911.

G. (*Lipophleps*) *flavocostalis* Alexander.
Rhabdomastix (*Sacandaga*) *japonica* Alexander.
Helobia hybrida (Meigen).
Molophilus sericatus Alexander.
Erioptera (*Erioptera*) *elegantula* Alexander.
E. (*E.*) *horii* Alexander.
E. (*E.*) *orbitalis* Alexander.
E. (*Acyphona*) *asymmetrica* Alexander.
E. (*A.*) *yezoana* Alexander.
E. (*Hoplolabis*) *asiatica* Alexander.
Oropeza satsuma Alexander.
Nesopeza geniculata Alexander.
Ctenophora biguttata Matsumura.
Cnemoncosis nohirae (Matsumura).
C. uniplagiata Alexander.
Pselliophora septentriönalis Alexander
Dictenidia fasciata Coquillett, variety.
Tanyptera angustistylus Alexander.
T. jozana (Matsumura).
Tipula bubo Alexander.
T. coquilletti Enderlein.
T. fumida Alexander.
T. isshikii Alexander.
T. kuwayamai Alexander.
T. latemarginata Alexander.
T. matsumuriana Alexander.
T. moiwana (Matsumura).
T. nova Walker.
T. nipponensis Alexander.
T. saitamae Alexander.
T. shogun Alexander.
T. subcunctans Alexander.
T. taikun Alexander.
T. tateyamae Alexander.
T. teshionis Alexander.
T. trifida Alexander.
T. verecunda Alexander.
T. yamata Alexander.
Nephrotoma angustistria Alexander.
N. cornicina (Linnaeus), variety.
N. dorsalis sachalina Alexander.
N. esakii Alexander.
N. hirsuticauda Alexander.
N. hokkaidensis Alexander.
N. microcera Alexander.
N. minuticornis Alexander.
N. neopratensis Alexander.
N. nigricauda Alexander.
N. parvirostra Alexander.
N. stygia Alexander.

Two species of the related family Ptychopteridae are likewise found in Hokkaido: *Ptychoptera daimio* Alexander and *P. subscutellaris* Alexander.

Family TIPULIDAE

Subfamily LIMONIINAE

Tribe LIMONIINI

Genus LIMONIA Meigen

1803. *Limonia* MEIGEN, Illiger's Mag., vol. 2, p. 262.
1818. *Limnobia* MEIGEN, Syst. Beschr. Zweifl. Ins., vol. 1, p. 116.

LIMONIA KARAFUTONIS Alexander

1924. *Limonia karafutonis* ALEXANDER, Philippine Journ. Sci., vol. 24, pp. 550–551.

One female, Amagu Village, Siberia, July 1923 (T. D. A. Cockerell). This specimen closely resembles the type from Sakhalin, but has the lateral spots on the mesonotal praescutum, together with thoracic pleura, somewhat darker colored.

Genus DICRANOMYIA Stephens

1829. *Dicranomyia* STEPHENS, Cat. Brit. Ins., vol. 2, p. 243.

DICRANOMYIA IMMODESTOIDES Alexander

1919. *Dicranomyia immodestoides* ALEXANDER, Ann. Ent. Soc. Amer., vol. 12, pp. 327–328.

Males from Vladivostock, Siberia, and Olga, Siberia, July 1923. The species has an extensive range in Japan.

DICRANOMYIA SPINICAUDA Alexander

1924. *Dicranomyia spinicauda* ALEXANDER, Philippine Journ. Sci., vol. 24, pp. 545–546.

Specimens from Kudia River, Amagu, Siberia, July 1923 (T. D A. Cockerell). The species had been recorded only from Sakhalin and Hokkaido, Japan.

DICRANOMYIA AMURENSIS, new species

General coloration dark gray; pleura yellow, the sternopleurite darkened; wings yellowish subhyaline, the stigma pale; *Sc* short; male hypopygium with the mesal lobe of the basistyle complex; dorsal dististyle bent in the form of a rectangle, the apex narrowed.

Male.—Length about 6.8 mm.; wing, 8.2 mm.

Rostrum obscure brownish yellow, the palpi brown. Antennae relatively short, dark brown throughout, the flagellar segments oval, the more distal segments passing into cylindrical. Head dark gray.

Pronotum dark brownish gray medially, yellowish laterally. Mesonotal praescutum brownish gray, a little darker medially, the lateral margins indistinctly paler; scutal lobes dark; scutellum yellow; postnotal mediotergite pale basally with a little more than the apical half infuscated. Pleura yellow, the anepisternum with a vague suggestion of dusky; sternopleurite with its ventral portion strongly infuscated. Halteres of moderate length, pale, the knobs infuscated. Legs with the coxae yellowish testaceous, the fore coxae a little darker; trochanters brownish testaceous; femora concolorous, the tips infuscated; tibiae pale brown, the tips weakly infuscated; tarsi dark brown. Wings yellowish subhyaline, the base clearer yellow; stigma only faintly indicated; veins brown. Venation: *Sc* short, Sc_1 ending opposite the origin of *Rs*, the tip of R_1 extending a distance beyond *r* but not reaching costa; *Rs* relatively long, more than twice the basal deflection of R_{4+5}; basal deflection of Cu_1 at the fork of *M*.

Abdominal tergites dark brown, the caudal margins of the segments narrowly pale; sternites infuscated, the lateral margins

narrowly yellowish; hypopygium with the tergite and basistyles infuscated. Male hypopygium (fig. 1) with the ninth tergite nearly transverse, the median area very slightly produced into a low, dark tubercle. Basistyles small, the mesal lobe very large, the apex blackened and set with numerous setigerous tubercles. Ventral dististyle moderately fleshy with a long slender rostrum (fig. 1B) that bears at its tip a slender spinous seta and a few more delicate bristles; two relatively short spines, placed less than their own length apart and not far from the base of the rostrum. Dorsal dististyle a very strongly curved chitinized rod, the base stout, the apex beyond the approximately rectangular curve narrowed, feebly dilated before the acute straight apex. Gonapophyses with the mesal apical angle of each produced caudad into a dusky nearly straight lobe. Aedeagus stout.

Described from a single male, collected at Amagu Village, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28358, U.S.N.M.

DICRANOMYIA, species, near PSEUDOMORIO Alexander

1920. *Dicranomyia pseudomorio* Alexander, Trans. Amer. Ent. Soc., vol. 46, pp. 3–4.

One badly damaged specimen that probably belongs here, Kudia River, Amagu, Siberia, July 1923 (T. D. A. Cockerell).

Genus RHIPIDIA Meigen

1818. *Rhipidia* Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 153.

RHIPIDIA (RHIPIDIA) MACULATA Meigen

1818. *Rhipidia maculata* Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 153, pl. 5, fig. 11.

One male, Kongaus, Siberia, August 1923 (T. D. A. Cockerell). This fly is distributed throughout the Holarctic region.

RHIPIDIA (MONORHIPIDIA) SIBIRICA, new species

General coloration dark; fore legs dark brown, the basal quarter paler; wings with a grayish tinge, the costal cell darker; brown spots and seams at origin of *Rs*, tip of *Sc*, along the cord and outer end of cell *1st* M_2; *Sc* long, ending beyond midlength of *Rs*.

Female.—Length, 7 mm.; wing, 7.8 mm.

Rostrum and palpi black. Antennae black throughout, the flagellar segments with distinct basal petioles, the inner face of each segment slightly produced. Head dark, discolored.

Thorax entirely dark-colored, any bloom or pattern that might be normally present destroyed by moisture. Halteres pale, the knobs slightly darkened. Legs with the coxae dark brown, discolored, the

tips brightened; trochanters obscure yellow; femora obscure yellow basally, dark brown towards the tips; on the forelegs the femora are dark brown with the exception of the basal fourth; middle and hind femora with the extreme tips a little paler than the subterminal darkened portions; tibiae and tarsi dark brown. Wings with a grayish tinge, the costal cell strongly infuscated; conspicuous brown spots at origin of *Rs* and tip of *Sc;* stigma brown, sending seams caudad onto *r* and to the fork of *Rs;* posterior cord and outer end of cell *1st* M_2 more narrowly seamed with brown; wing-tip in cells *2nd* R_1, R_3, R_5, and *2nd* M_2 more weakly infuscated, especially in the centers of the cells; veins pale brown, the prearcular veins and *Cu* more yellowish. Venation: Sc_1 ending beyond mid-length of *Rs*, Sc_2 only a trifle shorter than Sc_1; *Rs* long, arcuated at origin; *r* at tip of R_1; inner end of cell R_3 lying a little proximad of that of cell *1st* M_2; cell *1st* M_2 gently widened distally, *m* about equal to the outer deflection of M_3; basal deflection of Cu_1 at the fork of *M*.

Abdominal tergites dark brown, the sternites a little paler, yellowish brown, especially the intermediate segments. Ovipositor with the tergal valves slender, gently upcurved, the tips acute; sternal valves stout, relatively straight, the base abruptly blackened.

Described from a single female, collected at Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

Type.—Female, Cat. No. 28359, U.S.N.M.

Rhipidia (*Monorhipidia*) *sibirica* is allied to *R.* (*M.*) *uniseriata* Schiner (Western Palaearctic) and *R.* (*M.*) *fidelis* Osten Sacken (Eastern Nearctic), differing in the venation and coloration of the legs.

RHIPIDIA (ARHIPIDIA) PULCHRA SEPTENTRIONIS Alexander

1913. *Rhipidia pulchra septentrionis* ALEXANDER, Can. Ent., vol. 45, pp. 206–207, pl. 3, fig. 1 (wing).

Specimens from Vladivostok and Kudia River, Amagu, Siberia, July 1923 (T. D. A. Cockerell). The northern form of the Oriental *pulchra* is widely distributed throughout the Japanese Empire but had not previously been recorded from Siberia.

Tribe HEXATOMINI

Genus PSEUDOLIMNOPHILA Alexander

1919. *Pseudolimnophila* ALEXANDER, Cornell Univ. Agr. Expt. Sta., Mem. 25, p. 917.

PSEUDOLIMNOPHILA OCHRACEA ASIATICA, new subspecies

Female.—Length about 9 mm.; wing, 9 mm., its width, 2.8 mm.

Generally similar to typical *ochracea* (Meigen) of the Western Palaearctic Region, differing as follows:

Basal segment of the flagellum largely yellow, the tip darkened. Legs yellow, the tips of the tibiae and the tarsi infuscated. Wings with *Rs* short and strongly arcuated at origin; R_{2+3} longer; cell R_2 correspondingly shorter, the distal section of vein R_2 sinuous; cell M_1 nearly sessile; basal deflection of Cu_1 at two-fifths the length of the cell *1st* M_2 and less than its length beyond the fork of *M*; cell *2nd A* broader. Wings conspicuously broader than in the typical form.

Described from a female, collected at Okeanskaja, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Female, Cat. No. 28360, U.S.N.M.

Genus LIMNOPHILA Macquart

1834. *Limnophila* Macquart, Suit. a Buff., vol. 1, Hist. Nat. Ins., Dipt. p. 95.

LIMNOPHILA (LIMNOPHILA), species, near PICTIPENNIS (Meigen)

1818. *Limnobia pictipennis* Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 119.

A female, Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell). The Palaearctic species of this subgenus have not yet been satisfactorily differentiated.

LIMNOPHILA INCONCUSSA Alexander

1913. *Limnophila inconcussa* Alexander, Can. Ent., vol. 45, pp. 313–314, pl. 4, fig. 2 (wing); pl. 10, fig. 12 (male hypopygium).

Two specimens taken at Tsuruga, Japan, August 1923, by Professor and Mrs. Cockerell. This is the commonest and most widely distributed member of the genus in Japan, extending southward into Taiwan.

LIMNOPHILA NEMORALIS (Meigen), variety

1818. *Limnobia nemoralis* Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 126.

One male specimen, Olga, Siberia, July 1923 (T. D. A. Cockerell).

Genus PILARIA Sintenis

1888. *Pilaria* Sintenis, Sitzber. Nat.-Ges. Dorpat, vol. 8, p. 398.

PILARIA FUSCIPENNIS (Meigen), variety

1818. *Limnobia fuscipennis* Meigen, Syst. Beschr. Zweifl. Ins., vol. 1, p. 125.

Specimens from Amagu Village, Siberia, July 1923 (T. D. A. Cockerell).

Tribe PEDICIINI

Genus PEDICIA Latreille

1809. *Pedicia* LATREILLE, Hist. Nat. Crust. et Ins., vol. 4, p. 255.
1916. *Daimiotipula* MATSUMURA, Thous. Ins. Japan, add. 2, p. 463.

PEDICIA COCKERELLI, new species

General coloration gray and yellow; wings with the costal margin pale brown, the remaining markings dark brown but restricted in extent; basistyle of male hypopygium produced into a slender acute horn.

Male.—Length, 20 mm.; wing, 19.5 mm.

Rostrum and palpi dark brown. Antennae brown, the basal segments of the flagellum short and crowded, the terminal segments elongate and with conspicuous verticils. Head dark gray; vertical tubercle distinct.

Pronotum obscure yellow, the sides of the anterior notum with a brown spot. Mesonotal praescutum yellow with four distinct brown spots, the intermediate pair only vaguely separated from one another by a capillary pale line; lateral stripes crossing the suture onto the scutal lobes; scutellum yellow; postnotal mediotergite testaceous, darkened behind. Pleura yellowish testaceous, the sternopleurite darkened ventrally; postnotal pleurotergite with a dark spot at the base of the halter. Halteres pale, the knobs obscure yellow. Legs with the coxae and trochanters light brown; femora yellow, the tips conspicuously blackened; tibiae brownish yellow, the bases narrowly and indistinctly, the tips more broadly and conspicuously, infuscated; tarsi brown. Wings of the usual *Pedicia* pattern, the costal margin much paler brown than the remaining dark markings, the humeral region almost yellow; brown seam along vein Cu_2 continued to the margin but becoming less defined outwardly; brown markings less extensive than in *daimio* (Matsumura); a pale spot in cell R_1 opposite the level of the cord, as in *daimio*.

Venation: Cell *1st* M_2 relatively small; petiole of cell M_1 nearly twice m; basal deflection of Cu_1 a short distance beyond the fork of M.

Abdominal segments nearly uniform rusty brown, without distinct darker markings in the rubbed unique type; hypopygium passing into brown. Male hypopygium with the ventral apical angle of each basistyle (fig. 2) produced into a shiny, acutely pointed horn that is gently curved, these horns directed dorsad and slightly mesad, the apex of each horn deeply grooved on ventral mesal face, the apex microscopically bifid; dorsal apical angle of basistyle with rather numerous yellow setae. Dististyles elongate, darkened, the apex shiny, obtuse.

Described from a single male, collected at Olga, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28361, U.S.N.M.

This interesting new species is named in honor of the collector, Prof. T. D. A. Cockerell.

Genus RHAPHIDOLABINA Alexander

1916. *Rhaphidolabina* ALEXANDER, Proc. Acad. Nat. Sci. Phila., pp. 540–541.

RHAPHIDOLABINA SIBIRICA, new species

General coloration pale whitish yellow; legs yellow, only the terminal tarsal segments infuscated; wings whitish subhyaline with a relatively heavy pale brown pattern, the costal region infuscated basally; *r* present; abdominal tergites indistinctly bicolorous.

Male.—Length about 5 mm.; wing, 6.5 mm.

Rostrum reddish flesh-color, the palpi pale yellow. Antennae short, the scapal segments reddish; flagellum yellow, the terminal segments a little infuscated. Head yellowish brown.

Pronotum and mesonotum very pale whitish yellow, without distinct markings. Pleura whitish yellow. Halteres pale, the knobs a little more yellowish. Legs whitish yellow, only the terminal tarsal segments infuscated. Wings whitish subhyaline, with a relatively heavy pale brown pattern; cell *1st C* and basal half of cell *2nd C* infuscated; interrupted areas in cells *Sc* and Sc_1, including a large basal area and spots at Sc_2, above the origin of *Rs* and at the tip of Sc_1; these dark areas in cell *Sc* extend caudad into cell *R* but do not quite reach vein *M;* narrow brown seams along the cord and outer end of cell *1st* M_2 and on the outer deflection of vein R_2; a circular brown cloud at tip of vein R_3 and a smaller one at tip of vein R_4; brown spots and dots at ends of veins M_2, M_3, Cu_1, Cu_2, and *2nd A;* smaller spots at fork of M_{1+2} and along the bases of veins *Cu, 1st A,* and *2nd A;* prearcular cells largely dark. Venation: *Rs* strongly angulated at origin; *r* present, as in *R. dicranotoides* Alexander (Japan); fusion of R_1 and tip of R_2 very short to punctiform; R_3 gently arcuated; cell M_1 a little longer than its petiole; cell *1st* M_2 with the inner end pointed, *r–m* close to this point; *m* about two-thirds the outer deflection of M_3; basal deflection of Cu_1 about two-fifths its length beyond the fork of *M.* Wings relatively broad, widest opposite the origin of *Rs.*

Abdomen with the tergites indistinctly bicolorous, the caudal margins darker brown than the bases; basal sternites pale yellow; hypopygium dark brown.

Described from a single male, collected at Amagu, Kudia River, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28362, U.S.N.M.

Tribe ERIOPTERINI

Genus MOLOPHILUS Curtis

1833. *Molophilus* CURTIS, Brit. Ent., p. 444.

MOLOPHILUS LOBIFERUS, new species

General coloration brown, including the thoracic pleura; halteres pale, the knobs yellowish; male hypopygium with each basistyle produced mesad and caudad into a fleshy setiferous lobe; apex of basistyle and dististyles totalling four chitinized arms.

Male.—Length about 3.6 mm.; wing, 4.5 mm.

Female.—Length about 4 mm.; wing, 5 mm.

Rostrum and palpi brown. Antennae of moderate length in the female, broken in the unique male, pale brown, the basal segments a little brighter. Head dark gray.

Mesonotum dark brown, the lateral margins of the praescutum a little paler. Pleura dark brown. Halteres pale, the knobs yellowish. Legs with the coxae and trochanters yellowish testaceous; remainder of legs obscure yellow, the tarsi passing into brown. Wings with a pale yellowish tinge, the veins pale brown. Venation: R_{4+5} about twice the basal section of vein R_5 alone; basal deflection of Cu_1 less than its length beyond the fork M; vein *2nd A* ending about opposite one-fourth the petiole of cell M_3.

Abdomen brown, the sternites and hypopygium a little paler. Male hypopygium (fig. 4) with the basistyles stout, approximated on the ventral face, each here produced caudad and slightly mesad into a slender fleshy lobe that is provided with stout setae. Apex of basistyle produced into two long, powerful arms, the outer or lateral one directed caudad, before midlength bent strongly mesad into a long, nearly straight black spine; inner or mesal arm connected basally with the outer, shorter, heavily blackened, feebly sinuous. A third chitinized arm is longer than any of the others, weakly expanded on the distal half and here provided with small subappressed teeth, the apex acute. Another dististyle is present and chitinized, but in the unique type has been broken beyond the base which is dilated, thence narrowed and blackened; this appendage is not shown in the figure. Aedeagus long and slender, pale.

Described from a pair taken at Olga, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28363, U.S.N.M.

Genus ERIOPTERA Meigen

1803. *Erioptera* MEIGEN, Illiger's Mag., vol. 2, p. 262.

ERIOPTERA (ERIOPTERA) FUSCOHALTERATA, new species

General coloration pale reddish and yellow; halteres pale, the knobs conspicuously brownish black; legs yellow, the terminal tarsal

segments infuscated; wings pale yellow, the veins darker yellow; male hypopygium with the gonapophyses terminating in acute blackened horns.

Male.—Length about 4 mm.; wing, 5.4 mm.

Rostrum and palpi brown. Antennae pale reddish brown, the terminal segments more infuscated. Eyes large, contiguous beneath. Head yellow.

Mesonotum reddish, more or less discolored, the lateral margins of the praescutum and scutum light yellow, this color extending back to the wing-root; scutellum and lateral margins of the postnotal mediotergite similarily yellow. In normal specimens it is possible that this yellow color is much more extensive. Pleura reddish yellow. Halteres pale, the knobs conspicuously brownish black. Legs yellow, only the terminal tarsal segments infuscated. Wings pale yellow, the veins darker yellow. Venation: As in the subgenus; R_{2+3} about one-half longer than the basal section of R_2; vein *2nd A* very strongly sinuous.

Abdomen brownish yellow. Male hypopygium with the basistyles relatively stout. Outer dististyle apparently broken off at base. Inner dististyle (fig. 3) a strongly curved arm, pale except at the suddenly pointed apex which is blackened. Gonapophyses appearing as slender, nearly straight horns, the apical third blackened, the tips acute. Aedeagus lyriform, each half provided with a long, curved branch that is directed caudo-laterad, thence mesad and finally strongly cephalad.

Described from a single male taken at Amagu Village, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28364, U.S.N.M.

Genus HELOBIA St. Fargeau et Serville

1825. *Helobia* St. Fargeau et Serville, Encyclop. Method. Ins., vol. 10, p. 585.

1830. *Symplecta* Meigen, Syst. Beschr. Zweifl. Ins., vol. 6, p. 282.

HELOBIA HYBRIDA (Meigen)

1804. *Limonia hybrida* Meigen, Klass., vol. 1, p. 57, pl. 3, fig. 17.

One specimen, Vladivostock, Siberia, 1923 (T. D. A. Cockerell). This common crane fly is very widely distributed throughout the Holarctic Region.

Genus TRIMICRA Osten Sacken

1861. *Trimicra* Osten Sacken, Proc. Acad. Nat. Sci. Phila., p. 290.

TRIMICRA PILIPES (Fabricius)

1787. *Tipula pilipes* Fabricius, Mantissa Ins., vol 2, p. 324.

One male, Kongaus, Siberia, August 1923 (T. D. A. Cockerell). If most of the numerous described species of *Trimicra* are synonyms

of *pilipes*, as would now appear to be the case, the present fly has the most extended range of any Tipulid, being found in virtually all parts of the world, including many of the most remote oceanic islands.

Genus GONOMYIA Meigen

1818. *Gonomyia* MEIGEN, Syst. Beschr. Zweifl. Ins., vol. 1, p. 146.

GONOMYIA (GONOMYIA), species, near SUPERBA Alexander

1913. *Gonomyia* (*Gonomyia*) *superba* ALEXANDER, Can. Ent., vol. 45, pp. 285–286, pl. 3, fig. 14 (wing); pl. 10, figs. 1–2 (hypopygium).

A single badly damaged specimen, Amagu Village, Siberia, July 1923 (T. D. A. Cockerell), that appears to belong here. The species is the most widely distributed Japanese member of the genus.

Genus RHABDOMASTIX Skuse

1889. *Rhabdomastix* SKUSE, Proc. Linn. Soc. N. S. Wales, ser. 2, vol. 4, pp. 828–829.

RHABDOMASTIX (SACANDAGA) USURIENSIS, new species

General coloration black, light gray pruinose; knobs of halteres conspicuously light yellow; wings with a strong brown tinge; veins R_1 and R_2 widely separated at wing-margin; R_3 longer than R_{2+3}.

Male.—Length about 3.5–3.6 mm.; wing, 4.5–4.6 mm.

Rostrum and palpi black. Antennae short, black, the flagellar segments oval. Head black, heavily light gray pruinose.

Pronotum and mesonotum black, light gray pruinose; pseudosutural foveae black. Pleura gray pruinose. Halteres dark brown, the knobs conspicuously pale yellow. Legs with the coxae and trochanters black, gray pruinose; femora and tibiae dark brown, the bases of the former vaguely paler; tarsi black. Wings with a strong brown tinge, the veins still darker brown. Venation: Sc_1 ending between one-third to two-fifths the length of the long, nearly straight Rs, Sc_2 close to its extreme tip but relatively indistinct; R_2 oblique, at the wing-margin separated from the tip of R_1 by a distance greater than its own length; R_3 longer than R_{2+3}, cell R_2 thus being relatively large; r lacking. Anal angle of wing moderately developed. No macrotrichiae on veins Rs, R_{2+3}, R_2 or R_3; numerous trichiae on R_{4+5} for its entire length.

Abdomen black, gray pruinose; hypopygium black.

Described from three males collected at Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28365, U.S.N.M.

Subfamily TIPULINAE

Tribe TIPULINI

Genus DICTENIDIA Brullé

1833. *Dictenidia* BRULLÉ, Ann. Soc. Ent. France, vol. 2, pp. 401–402.

DICTENIDIA BIMACULATA (Linnaeus)

1761. *Tipula bimaculata* LINNAEUS, Fauna Suec., ed. 2, p. 433.

One male, Kongaus, Siberia, August 1923 (T. D. A. Cockerell); a pair, Kudia River, Amagu, Siberia, July 1923 (T. D. A. Cockerell). A critical comparison with European specimens reveals no differences between these flies.

Genus TIPULA Linnaeus

1758. *Tipula* LINNAEUS, Syst. Natur., ed. 10, p. 585.

TIPULA COCKERELLIANA, new species

Allied to *T. fulvipennis* de Geer, *T. shirakii* Edwards, and similar species; general coloration grayish yellow, the praescutum with four brown stripes; wings with a strong yellowish brown suffusion, the obliterative band before the cord very broad and conspicuous, cream-colored.

Female.—Length, 28 mm.; wing, 23 mm.

Frontal prolongation of head relatively elongate, brown; nasus conspicuous; palpi dark brown. Antennae with the scapal segments brownish yellow; flagellar segments feebly bicolorous, the basal enlargement darker brown than the ground-color; verticils long and conspicuous. Head dark brown, gray pruinose.

Mesonotal praescutum grayish yellow with four brown stripes, the intermediate pair narrowly separated from one another by a gray line; scutal lobes dark brown, each with two dark gray markings; scutellum brownish yellow, the center of the disk grayish brown; postnotum dark but heavily yellowish pollinose to virtually obliterate the ground-color. Pleura yellowish testaceous, the posterior margins of the postnotal pleurotergite weakly infuscated. Halteres brown, the bases of the stems and the apices of the knobs paler. Legs with the coxae and the trochanters yellow; femora yellow, the tips broadly and conspicuously dark brown, the tibial apices more narrowly infuscated; tarsal segments one to three brownish yellow, the tips of the individual segments narrowly darkened, the terminal tarsal segments uniformly infuscated. Wings with a strong yellowish brown suffusion, the stigma darker; cells beyond the cord somewhat darker than the basal cells; a brown cloud near mid-length of cell *Cu*, preceded by a clearer yellow area, the latter continued into cell *M;* a very broad and conspicuous creamy obliterative mark

crosses the wing before the cord, narrowest in cell *C* at the tip of vein *Sc*, and at the posterior margin of the wing on both sides of vein Cu_1; this area includes more than the basal half of cell *1st* M_2; additional pale blotches in outer half of cell R_5, in base of cell M_1 and restrictedly in cell *2nd* M_2; veins brown, paler in the costal region and radial field. Venation: R_2 persistent; *m* longer than the petiole of cell M_1; *m–cu* punctiform; cell *2nd A* broad.

Abdominal tergites brownish yellow, the base of the abdomen brighter, the segments with ill-defined sublateral brown stripes; posterior segments with indications of a median vitta; sternites more uniformly yellowish. Ovipositor with the valves long and straight, especially the slender tergal valves.

Described from a single female, taken at Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

Type.—Female, Cat. No. 28366, U.S.N.M.

TIPULA LIGULIFERA, new species

Antennae of male moderately elongate; flagellum black, the basal enlargement of each segment conspicuously light yellow; wings brownish yellow; cell M_1 short-petiolate to sessile; male hypopygium with the eighth sternite produced caudad into a conspicuous liguliform blade.

Male.—Length, 12–13 mm.; wing, 11.2–11.5 mm.

Frontal prolongation of head relatively short, brownish yellow; nasus long but relatively stout, concolorous. Antennae moderately elongate, if bent backward, extending about to the base of the abdomen; scapal segments light brown; flagellar segments black, the basal enlargements of the individual segments conspicuously light yellow, this greater in amount on the basal segments, becoming more restricted in extent on the outer segments; verticils relatively short but stout. Head light brown, the orbits indistinctly paler.

Pronotum testaceous brown. Mesonotal praescutum obscure brownish yellow with four slightly darker, ill-defined brownish stripes; centers of scutal lobes darkened; remainder of the mesonotum brownish testaceous. Pleura whitish testaceous, the pleurotergite brighter. Halteres pale brown, the base of the stem paler. Legs with the coxae whitish testaceous; trochanters pale yellow; femora and tibiae light brown, the tarsi passing into dark brown. Wings with a strong brownish yellow tinge, the base and costal region more yellowish; stigma small, oval, pale brown; a conspicuous obliterative area before the stigma, extending from vein R_1 before and including the cord, crossing the proximal end of cell *1st* M_2 into the base of cell M_3; veins brown. Venation: *Rs* moderately elongate, arcuated, about one-half longer than R_{2+3}; R_2 preserved throughout its length; cell *1st* M_2 long

and narrow, its outer end more or less pointed, *m* being longer than the petiole of cell M_1; in some specimens, the latter vein is very short to obliterated, in the latter case cell M_1 being sessile; *m-cu* elongate; cell *2nd A* moderately broad.

Abdomen pale brown, the basal segments paler, the surface of the sclerites with appressed yellow setae; dorso-median line of the tergites darker. Male hypopygium relatively small; caudal margin of the tergite (fig. 7) with a V-shaped notch, the margin of which is provided with microscopic black spinulae. Outer dististyle elongate, fleshy. Inner dististyle terminating in a conspicuous black spine, directed dorsad. Region of ninth sternite deeply and narrowly incised. Eighth sternite bearing a very conspicuous, thin, liguliform blade, median in position and light yellow in color.

Described from three males, collected at Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28367, U.S.N.M.

TIPULA AMURENSIS, new species

Belongs to the *hebes* group; antennae elongate, the flagellum uniformly dark brown; general coloration light gray, the lateral praescutal stripes ill-defined; male hypopygium with the eighth sternite densely short-hairy.

Male.—Length, 13 mm.; wing, 14 mm.

Frontal prolongation of head dark yellow, with an indistinct darker lateral line; nasus distinct; palpi brownish yellow, the terminal segments a little darker. Antennae elongate, the terminal segments broken, if entire and bent backward, extending to beyond the base of the abdomen; scapal segments dark yellow; first segment of flagellum brownish yellow on basal half, passing into dark brown; remaining segments of flagellum dark brown, the basal enlargement of the proximal segments a very little brighter. Head with the anterior part of the vertex surrounding the antennal bases buffy, the remainder of the vertex dark gray with an indistinct brown median line.

Pronotum buffy yellow, a trifle darker medially. Mesonotum clear gray, the praescutum with a pair of ill-marked brown stripes, intermediate in position, narrowly separated from one another and further divided by a capillary dark vitta on the anterior half of the sclerite; lateral stripes of a brighter gray than the ground-color, their anterior ends bordered by brown; scutum light gray with an anterolateral brown spot and a postero-mesal brown circle enclosing a gray center; scutellum and postnotum dirty gray with indications of a capillary darker median vitta. Pleura with the anepisternum and sternopleurite light gray, the posterior pleurites and postnotal pleurotergite more whitish. Halteres slender, brownish yellow, the tips

of the knobs obscure yellow, the base of the stem narrowly paler. Legs with the coxae pale, sparsely pruinose; trochanters yellow; femora brownish yellow, the tips conspicuously blackened; tibiae light brown, the tips narrowly dark brown; tarsi dark brown. Wings with a grayish brown tinge, the base and costal region yellow; stigma brown; wing-apex darker brown; conspicuous subhyaline areas beyond the cord and stigma, appearing as an oblique band from the costa through cell *1st* M_2 into the base of cell M_4; a smaller pale area before the stigma in cell *1st* R_1; a large pale spot before the end of cell *M*, crossing vein *Cu* into cell *Cu*; a small pale spot on vein *1st A* near one-third its length, the space between these two latter subhyaline areas a trifle more infuscated than the ground-color; anterior cord and origin of *Rs* slightly infuscated; veins brown, dark yellow in the flavous areas. Venation: R_2 preserved, widely divergent from R_3; petiole of cell M_1 shorter than *m*; cell *1st* M_2 elongate, its principal faces parallel.

Abdomen with the basal two tergites yellow, the remaining tergites brown, each with gray lateral and caudal margins and a median and sublateral dark brown longitudinal stripes; on the subterminal segments, the pale lateral margins are very broad and conspicuous, more yellowish; sternites generally similar with pale caudal margins. Male hypopygium (fig. 6) as in the *hebes* group; tergite dark brown, narrowed posteriorly, the caudal margin nearly truncate, with a very low, blunt, median lobe that is light yellow (fig. 5). Outer dististyle flattened, irregularly oval, pale. Ventral mesal portions of the basistyle produced mesad into a pale, submembranous blade that is irregularly bifid at apex on median line, the dorsal arm with the margin narrowly blackened, overlying its mate of the opposite side; posterior lobes directed ventrad as an apron-like structure that lies in the notch of the eighth sternite. Gonapophyses projecting ventrad from this notch, chitinized, narrowed to the tips which are weakly toothed. Eighth sternite deeply incised, the incision densely filled with relatively short, golden-yellow setae.

Described from a single male, collected at Amagu, Kudia River, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28368, U.S.N.M.

TIPULA LATEMARGINATA Alexander

1921. *Tipula latemarginata* ALEXANDER, Ann. Ent. Soc. Amer., vol. 14, pp. 128–129.

One male, Amagu, Kudia River, Siberia, July 1923 (T. D. A. Cockerell). The species has an extensive distribution in Japan.

TIPULA BUBO Alexander

1918. *Tipula bubo* Alexander, Journ. N. Y. Ent. Soc., vol. 26, pp. 69–70.

One male, Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell). The fly had hitherto been known from Saghalien, Hokkaido and Honshiu, Japan.

TIPULA USURIENSIS, new species

General coloration gray; wings pale yellowish brown, the stigma pale brown; abdominal tergites bilineate with dark brown; male hypopygium with the sclerites fused into a continuous ring; emargination of the ninth sternite with two fleshy flattened lobes, margined with long yellow setae.

Male.—Length about 12 mm.; wing, 13.5 mm.

Frontal prolongation of head brownish yellow above, paler laterally; palpi dark brown. Antennae moderately elongate, if bent backward, extending about to the base of the abdomen; black, the second scapal segment and the base of the first flagellar segment brownish yellow. Head dark-colored, gray pruinose, the anterior part of the vertex obscure yellow.

Thorax of the unique type badly discolored; gray, the praescutum with four darker stripes; scutellum largely pale. Pleura pale, with sparse brownish markings; postnotal pleurotergite likewise pale. Halteres pale brownish yellow, the base of the stem brighter. Legs with the coxae dark, paler apically; trochanters yellow; femora brownish yellow, the tips extensively brownish black; tibiae brown, the tips gradually deepening into black; tarsi long and slender, dark brown. Wings with a pale yellowish brown tinge, the base and costal region somewhat brighter colored; stigma relatively small, oval, pale brown; obliterative areas before the cord relatively indistinct, more evident before the stigma at the end of *Rs* and across the proximal end of cell *1st* M_2; veins dark brown, those in the flavous areas brownish yellow. Venation: *Rs* very long and almost straight, in alignment with R_{2+3}; tip of R_1 atrophied, the subterminal section of the vein being in alignment with *r* which bears macrotrichiae throughout its length; distal section of vein R_2 entirely preserved; cell M_1 nearly twice its petiole; cell *1st* M_2 long and narrow; *m–cu* distinct, about twice its length beyond the fork of *M;* cell *2nd A* relatively narrow.

Abdominal tergites buffy yellow, with a sublateral brown longitudinal stripe on either side; hypopygium darker. Male hypopygium with the tergite and sternite fused in a continuous ring (fig. 11). Ninth tergite (fig. 10) relatively small, the caudal margin with a small lobe on either side of the median line, the apex of each lobe blackened and densely set with black spines; caudo-lateral angles of the tergite subacute. Outer dististyle cylindrical but very short,

bearing conspicuous long black setae. Inner dististyle a long flattened blade, gradually narrowed to the slender black apex. Median area of ninth sternite membranous, on either side of the median line with a fleshy flattened lobe, directed caudad, the outer margin fringed with long yellow setae. Eighth sternite unarmed.

Described from a single male, collected at Amagu, Kudia River, Siberia, July 1923 (T. D. A. Cockerell).

Type.—Male, Cat. No. 28369, U.S.N.M.

TIPULA SIBIRIENSIS, new species

General coloration gray; wings with a faint yellowish tinge, the base and costal region strongly yellow, the disk clouded with pale brown; a broad band of the ground-color beyond the cord completely traverses the wing; tip of vein R_2 atrophied.

Male.—Length about 13 mm.; wing, 17 mm.

Frontal prolongation of head yellowish gray; nasus distinct; palpi elongate, dark brown. Antennae of moderate length, if bent backward extending beyond the wing-root; scapal segments and first flagellar segment yellow; remaining flagellar segments yellow, the basal enlargements of the individual segments black; on the subterminal and outer segments, the ground-color becomes more infuscated. Head dark gray, the anterior part of the vertex more yellowish; vertex with a vaguely indicated brown median line.

Pronotum gray, the anterior notum tumid dorso-medially and more tinged with brown. Mesonotal praescutum light gray with four vaguely defined brownish gray stripes that are better delimited near the suture; scutum light gray, the centers of the lobes marked with darker; scutellum gray, more or less infuscated basally; postnotum light gray. Pleura clear light gray, the dorso-pleural membrane buffy-yellow. Halteres pale yellow, the knobs infuscated. Legs with the coxae light gray; trochanters dark yellow; femora brownish yellow, near mid length passing into brown; tibiae brown, the tips becoming still darker brown; tarsi brownish black. Wings with a faint yellowish tinge, the base, costal region and the space behind vein *Cu* strongly yellowish; stigma oval, dark brown; a small brown spot at origin of *Rs* and conspicuous seams on the branches of *Cu*; paler brown clouds in the cells, darker at the wing-apex, restricting the ground-color to a broad conspicuous cross-band beyond the cord, extending from the costal margin beyond the stigma, passing caudad through the bases of cells R_2, R_3, R_5, and all of cell *1st* M_2, through cell M_4 to the wing-margin; cell *M* is largely pale with a brown cloud near mid-length and another at its outer end; cell *1st A* largely suffused with pale brown, interrupted by a pale area near the basal third; veins dark brown, paler in the flavous areas. Venation: Tip of vein R_2

abruptly atrophied, the basal spur (about one-half the total length) provided with macrotrichiae; *m* and petiole of cell M_1 subequal; *m-cu* punctiform, near one-third the length of the cell.

Abdomen with the basal segments yellow, the tergites with a rather indistinct dorso-median stripe that is interrupted at the posterior margins of the segments; subterminal sternites darker. Male hypopygium (fig. 8) with the ninth tergite large, the lateral lobes produced caudad into flattened, obtuse blades, the mesal edge being produced slightly into flattened chitinized flanges; caudal notch of tergite broadly rounded, the dorso-median portion of the sclerite produced caudad for a slight distance into this indentation, which is thus feebly bifid at its base (fig. 9). Outer dististyle relatively large, pale, somewhat flattened. Ventral mesal margin of basistyle an oval, dark-colored fleshy lobe, the mesal edge provided with sparse erect yellow setae lying across the genital chamber. Eighth sternite with the caudal margin provided with an even fringe of conspicuous elongate yellow setae.

Described from a single male, collected at Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

Type—Male, Cat. No. 28370, U.S.N.M.

Genus NEPHROTOMA Meigen

1803. *Nephrotoma* Meigen, Illiger's Mag., vol. 2, p. 262.
1834. *Pachyrrhina* Macquart, Hist. Nat. Ins., Dipt. vol. 1, p. 88.

NEPHROTOMA VIRGATA (Coquillett)

1898. *Pachyrrhina virgata* Coquillett, Proc. U. S. Nat. Mus., vol. 21, p. 306.

Several specimens from various Siberian localities apparently belong here. Vladivostock, 1923. Okeanskaja, August 1923. Kudia River, Amagu, July 1923 (T. D. A. Cockerell). The species is common and widely distributed throughout the Japanese Empire.

NEPHROTOMA CORNICINA (Linnaeus), variety

1758. *Tipula cornicina* Linnaeus, Syst. Natur., ed. 10, p. 586.

Three males from Okeanskaja, Siberia, August 1923 (T. D. A. Cockerell).

NEPHROTOMA ACULEATA (Loew), variety

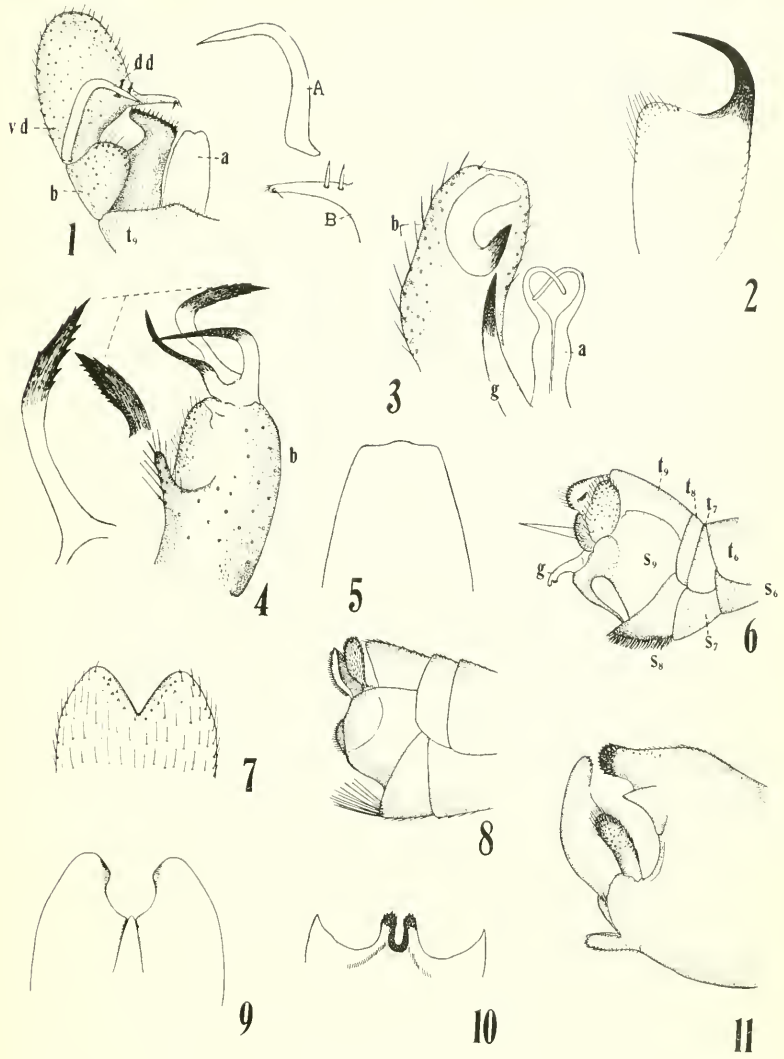
1871. *Pachyrrhina aculeata* Loew, Beschr. Eur. Dipt., vol. 2, p. 20.

A male, Amagu Village, Siberia, July 1923 (T. D. A. Cockerell). The typical form is from the Western Palaearctic Region.

EXPLANATION OF PLATE

a=aedeagus; *b*=basistyle; *d. d*=dorsal dististyle; *g*=gonapophyse; *s*=sternite; *t*=tergite; *v. d.*=ventral dististyle.

FIG. 1. *Dicranomyia amurensis*, new species; male hypopygium. *A*= Dorsal dististyle, enlarged; *B*=Tip of rostral appendage, enlarged.
2. *Pedicia cockerelli*, new species; male hypopygium. Basistyle.
3. *Erioptera fuscohalterata*, new species; male hypopygium.
4. *Molophilus lobiferus*, new species; male hypopygium. Enlarged figures show different aspects of dististyle.
5. *Tipula amurensis*, new species; male hypopygium. Ninth tergite.
6. *T. amurensis*; male hypopygium. Lateral aspect.
7. *T. ligulifera*, new species; male hypopygium. Ninth tergite.
8. *T. sibiriensis*, new species; male hypopygium. Lateral aspect.
9. *T. sibiriensis*; male hypopygium. Ninth tergite.
10. *T. usuriensis*, new species; male hypopygium. Ninth tergite.
11. *T. usuriensis*; male hypopygium. Lateral aspect.



CRANE FLIES FROM SIBERIA

FOR EXPLANATION OF PLATE SEE PAGE 21

TERTIARY INSECTS FROM KUDIA RIVER, MARITIME PROVINCE, SIBERIA

By T. D. A. Cockerell

Of the University of Colorado, Boulder

In a previous contribution[1] I have described two species of insects from the Tertiary rocks of the Kudia River, a tributary of the Amagu, in the Maritime Province of Siberia, North Latitude 46°. During July 1923, my wife and I, assisted by A. I. Lavrushin (or Lavrooshin), investigated this deposit, and collected the insects described below. We also obtained a good collection of plants, which will be described later by Dr. A. Kryshtofovich.

The exposure is very limited, and since it was visited by Mr. Kuznetzov the clay bank above it has fallen, covering the fossiliferous rocks with talus, which rests at such an angle that a little movement brings more down. It was therefore difficult to obtain much material, and the rock itself was comparatively unproductive, a day's labor in splitting it and turning it over sometimes giving little but fragments of *Sequoia*, *Alnus*, etc. Some of the best insects were found in the bed of the clear and cool Kudia River. Mr. Lavrushin went up and down the river, and also a considerable distance along the Amagu, in the hope of finding another exposure, but without success. He did, however, find a fragmentary fossil leaf on a hill overlooking the Kudia, but it was not in place. Doctor Kryshtofovich, from the collections of Kuznetzov, has identified a flora of 19 species from this deposit. These species are on the whole such as have been considered characteristic of the Eocene, though at least four are said to range upward to the Miocene, while five are not definitely referred to any species. The only new species (*Porana sichota-alinensis*) is related to a Miocene fossil. It must also be said, that the aspect of the flora is comparatively modern; in fact there is very little which can not be said to be closely allied to plants still living. We no longer find *Sequoia* or *Ginkgo* in the

[1] Proc. U. S. Nat. Mus., vol. 64, art. 13, no. 2503, 1924, pp. 1–15, pls. 1–2.

Siberian forests, but the *Alnus corylina* Knowlton and Cockerell (*corylifolia* Lesquereux), which is one of the most abundant of the fossils, and is represented by fruits and even what appears to be the bank, is entirely similar in aspect to the alders (*Alnus hirsuta*) growing in dense thickets at the very place where the fossils are found.

Kryshtofovich figures a *Pinus*, allied to the American *P. ponderosa*, with three leaves in the bundle. We found this abundantly, and remarked that no such pine existed in the same region to-day. However, we also found two other species of fossil pines, one with leaves in twos (like *P. sylvestris*) and the other with bundles of four slender leaves. This differentiation of *Pinus* is suggestive of the Miocene.

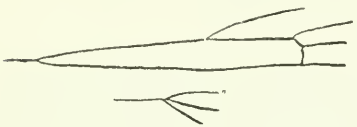


FIG. 1.—PART OF VENATION OF PHRYGANEA LAVRUSHINI

In the case of some of these fossil plants, too much importance should not be attached to the specific determination. Thus one of the species reported by Kryshtofovich is *Glyptostrobus europaeus* (Brongniart.) Of this species Berry writes:

> This species is exceedingly common at a large number of localities and horizons in the northern hemisphere throughout the Tertiary period. In North America it is represented from the basal Eocene to the Pliocene, and though it probably includes more than one botanic species no basis for its segregation except by geographic or geologic divisions is discernible.

The insects, although more numerous in species than the recorded plants, will not suffice to define the horizon, though on the whole I should imagine them to be Upper Oligocene or Lower Miocene.

TRICHOPTERA

Family PHRYGANEIDAE

PHRYGANEA LAVRUSHINI, new species

Plate 2, fig. 16

Anterior wing about 19 mm. long (the portion preserved 14.3 mm.), width fully 8 mm.; mottled with brown on upper two-fifths, especially toward the base; a well-defined stigmatic cloud; discoidal cell 6.8 mm. long, its base very acute, a large cloud in and above its apical end. Tertiary rocks of Kudia River, Amagu, Siberia, found by my assistant, A. I. Lavrushin, 1923.

Holotype.—Cat. No. 69593, U.S.N.M.

This is a broad-winged species resembling *P. latissima* Ulmer, from Baltic amber. The venation differs from *P. latissima* by R_2 leaving discoidal cell more basad, about 4.2 mm. from base of cell and 2.5 mm. from separation of R_3; separation of R_3 to end of discoidal cell only 0.5 mm.; fork at separation of R_2 very narrow, much

more so than in *P. cinerea*, etc. There is an approach to the Florissant Miocene *P. wickhami* Cockerell. In the Tertiary rocks at Posiet, Siberia, Doctor Kryshtofovich obtained cases of *Phryganea* (*P. kryshtofovichi* Cockerell), about 7 mm. wide, made of pieces of *Sequoia langsdorffi* spirally arranged exactly as in the living *P. grandis*. The pieces are about 5 mm. long and 1.2 wide. On the other hand, the cases from the Miocene of Oeningen, which Heer named *Phryganea antiqua*, do not belong to this genus.

AMAGUPSYCHINAE, new subfamily

Wings very broad; anterior wing similar in most respects (including characteristic region at end of cubitus) to that of *Phryganea*, but possessing a complete median cell, and two simple anals; media four-branched, but the fourth branch arises very obliquely close to the base of the median cell, and after a short distance is connected with the cubitus by a transverse cross vein; thus all five forks are present.

Type.—*Amagupsyche*, new genus.

This might be regarded as the type of a new family, but the structure so closely simulates Phryganeidae that I believe there is actual affinity, the fossil representing a branch of the phryganeid stem which has not persisted.

AMAGUPSYCHE, new genus

Anterior wing broad, mothlike, shaped approximately as in *Neuronia ruficrus*, not hairy, veins pale-brownish; subcosta apparently quite simple, ending very acutely on margin at about level of end of median cell; radius (R_1) stout, simple, not in the least undulate subapically, connected with R_2 by a transverse cross vein a short distance beyond discoidal cell, the vein R_2 bent at the cross vein; discoidal cell large, about as long as its stem, but not nearly so long as the distance from its end to apex of wing; side of discoidal between first and second forks somewhat oblique, face on first fork twice as long as that on second; median cell long-cuneiform, about as long as discoidal, cross vein to radius at a less distance from its end than the length of its apical side; first two branches of media (third fork) separating just before end of median cell; M_3 continuous to margin in line with lower side of median cell; M_4 leaving median cell obliquely very near its base, and connected with cubitus by a cross vein nearly as long as face of discoidal cell on first fork; end of cubitus forming a short triangular fork exactly as in *Phryganea;* first anal ending at base of cubital fork; second anal quite simple (it is also simple in *Marilia*, *Palaeolepidostoma*, *Maniconeurodes* and *Ogmomyia*), ending at same point as end of Cu_2.

Type.—*Amagupsyche perlata*, new species.

The wing spot at the base of the second fork is as in modern *Phryganea*.

AMAGUPSYCHE PERLATA, new species

Plate 2, fig. 14

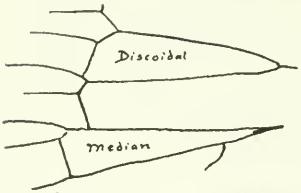


FIG. 2.—DISCOIDAL AND MEDIAN CELLS OF AMAGUPSYCHE PERLATA

Anterior wing 16 mm. long and 8 broad; uniform dilute fuliginous, not spotted; costal area dark fuscous. Length of discoidal cell 4 mm., its end to apex of wing about 7.5 mm.; length of median cell slightly over 4 mm.; length of cellula thyridii 6 mm., its base 4 mm., basad of level of base of discoidal; length of second anal 10 mm.

Tertiary of Kudia River, Siberia; both impressions found.

Holotype.—Cat. No. 69594, U.S.N.M.

Family LIMNEPHILIDAE

INDUSIA COMMINUTA, new species

Plate 2, fig. 12

Case cylindrical, straight, about 8 mm. long and 3 wide, at first sight appearing as if made of sand grains, but under the microscope seen to be covered with minute irregular vegetable fragments, not so closely disposed as to hide the entire surface. Only in one case is a very small short piece of *Sequoia* leaf employed. Some specimens are distinctly narrower at one end. Very abundant in Tertiary of Kudia River, Siberia. The name *Indusia* is employed for caddis-cases which cannot be referred to a definite genus. The reference of this and the next to Limnephilidae is provisional.

Holotype.—Cat. No. 69599, U.S.N.M.

INDUSIA SEQUOIAE, new species

Plate 2, fig. 13

Case cylindrical, straight, about 18 mm. long and 6 wide, composed of vegetable fragments, mainly short pieces of leaves of *Sequoia langsdorfii*, arranged irregularly, but obliquely transverse.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69595, U.S.N.M.

LIMNEPHILUS RECULTUS, new species

Plate 1, fig. 9

Anterior wing probably 18 mm. long, but only 15 mm. preserved, the base lost; width 7 mm.; apical cells (back to about 7 mm. from apex) clear hyaline, the rest of wing dilute fuliginous, but not

spotted; costal margin narrowly suffused with dusky to apex; venation so far as visible agreeing with *Limnephilus gravidus* Hagen, except that the tip of the longer enclosed anal cell is at the same level (distance from base) as the fork of radial sector, indeed slightly more apicad, the wing evidently being shorter. The broad apical portion resembles that of the *Limnephilus*. End of discoidal cell from tip of wing 7 mm.; length of discoidal cell 5.5 mm.; length of cellula thyridii about 5.3 mm., not going far basad of discoidal; veins delicate, pale-brown; discoidal cell on first fork no longer than breadth of its squarely truncate apex.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69596, U.S.N.M.

This seems a very convincing *Limnephilus*, but it must be admitted that the fossil *Phryganea longirostris* Hagen has a similarly broad wing, while *P. dubia* Pictet (which Pictet took for a *Limnephilus*) has the first fork going no great distance basad of apex of discoidal cell. *P. dubia* has a fourth fork, which our fossil lacks. All things considered, this surely must be a *Limnephilus;* a matter of interest since Limnephilidae are absent from Baltic amber. Assuming that the family invaded the Palaearctic region at a later date than the amber, we may get some light on the age of the Siberian deposit. Limnephilidae are found (two species) in the Miocene of Florissant.

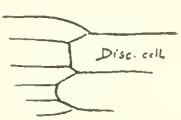


FIG. 3.—END OF DISCOIDAL CELL OF LIMNEPHILUS RECULTUS

A second specimen referred to *Limnephilus recultus* is less perfect, but shows the base, with both inclosed anal cells as usual, and the characteristic curve in the radius above end of discoidal cell. The apical area is not so conspicuously pale as in the type. The apex of the cellula thyridii is seen to be extremely oblique, a character favoring *Phryganea* rather than *Limnephilus*.

COLEOPTERA

Family CARABIDAE

PATROBUS(?) KUDIENSIS, new species

Plate 1, fig. 10.

Elytron 7.8 mm. long, 2.9 wide, nearly parallel-sided except at ends; humeral angle rounded, without tooth or prominence; apex broad, not acute, but not truncate; surface as preserved dull, apparently minutely granular, but not punctate, the color coffee-brown; eight well-defined but delicate striae, not counting two fine closely adjacent lines on shelflike outer margin; striae not punctate, and no punctures between striae on disk; submarginal punctures feebly indicated.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69597, U.S.N.M.

The general shape of the elytron might suggest *Pterostichus* or *Morio*, but there is no humeral projection or point, and the inner basal striae do not conform. As between *Patrobus* and *Scarites* I have found it hard to decide, but the elytron agrees better with *Patrobus* in that the submarginal sulcus fails to reach or approach the apex, and has at its end a row of small punctures. Also, the oblique groove mesad of this is indicated, though feebly. In the genus *Patrobus*, the species falls near *P. californicus* Motschulsky, and is quite different from such species of *P. longicornis* Say, in which the striae are punctured. In Leng's catalogue, *P. californicus* and its allies are referred to a distinct genus, *Platidius*, and our fossil should perhaps stand as *Platidius kudiensis.*

On the same stone, but on the other side, is a case of *Indusia comminuta.* It may be added that *Patrobus* proper is essentially a subarctic genus (Greenland, Alaska, Labrador, etc.), whereas *Platidius* has its maximum development in more southern regions. This tends to reinforce the suggested reference of the fossil to *Platidius.*

Family CURCULIONIDAE

CLEONUS SHAREIPOFFI, new species

Plate 1, fig. 11

Elytron 8 mm. long and 2.6 wide, parallel-sided, as preserved rather dilute brown; base truncate, apex broad but pointed; nine rows of strong punctures, evanescent (apparently abraded) apically, three or four punctures in one mm.; between the rows of punctures are very delicate longitudinal brown lines, not impressed; at the beginning of outer third of apical half is an obtuse longitudinal elevation or shoulder. The punctures are circular, not elongated.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69598, U.S.N.M.

Numerous Tertiary species have been referred to *Cleonus*, but few are as convincing as this, which has quite the aspect of the modern genus. I have given it a name commemorating Mr. Shareipoff, head man of the village of Amagu, who gave us much assistance in our undertaking.

ANTHONOMUS AMAGUENSIS, new species

Plate 1, fig. 7

Elytra brown, 4 mm. long and 1.3 wide, base broadly truncate, humeral angles rounded, apex rather acute. Seven longitudinal striae, consisting of rows of shallow punctures as in living species.

Surface with stout bristlelike structures (bristle-scales), exactly as in the living *A. grandis* Boheman. The apex is more acute than in *A. grandis*, and the punctured striae are fewer, but the specimen (a pair of elytra still joined) presents the dorsal view, and the lateral striae are presumably not visible.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69612, U.S.N.M.

Family THROSCIDAE

THROSCUS(?) PERITULUS, new species

Plate 1, fig. 8

Coffee-brown; prothorax 2 mm. wide and 1 mm. long, broadly rounded, forming less than a semicircle, truncate but not excavated in front, sides rapidly expanding posteriorly to end in a thin and sharp spine or thornlike angle, mesad of which the hind margin is broadly excavated; surface of prothorax and elytra minutely rugose or rugosopunctate; elytra slightly over 3 mm. long, and a little over 1 mm. wide, width of insect at middle of elytra 2.1 mm.; elytra with humeral angles prominent; first three-fifths of outer margin straight but the elytra slightly widening to the end of the straight portion, then rapidly contracting to the obtuse apex; no striae or distinct punctures, but some evidence of obtuse ridges, forming a sort of narrow reversed V, in the manner of the Buprestid *Anthaxia aeneogaster* Castelnau (specimen from near Ward, Colorado, compared). The thorax is wholly different from that of *Anthaxia*.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69600, U.S.N.M.

Had I only the elytra, I should imagine this to fall in the Buprestidae, in or near *Anthaxia*. The thorax is more like that of the Elateridae, except for its shortness. Thus the insect falls best in the Throscidae, but the reference to *Throscus* is to be taken in the broadest sense. As a possible alternative, I sought among the genera of Nitidulidae, but found nothing closely comparable.

Wickham described a Throscid (*Pactopus*) from the Miocene of Florissant; the specimen presents a ventral view, whereas ours presents the dorsal.

HYMENOPTERA

Family MEGACHILIDAE

MEGACHILE AMAGUENSIS, new species

Plate 1, fig. 1

Anterior wing 9 mm. long and about 3.6 mm. broad; fuliginous, with brown veins; marginal cell narrowly rounded at apex, away from costa; fold across first submarginal cell distinct; second sub-

marginal cell very long, receiving first recurrent nervure nearly as far from base as the length of first intercubitus, but the second recurrent practically at apex; basal nervure meeting nervulus on the basad side, the latter not in line with it, but directed a little apicad, bulging outwardly. The following measurements are in microns: Second submarginal cell on marginal, 960; lower side of first submarginal cell, 1184; first recurrent nervure from basal corner of second submarginal, 480; first recurrent to second (on second submarginal) 1280.

Tertiary rocks of Kudia River, Siberia.

Holotype.—Cat. No. 69601, U.S.N.M.

A true *Megachile*, by reason of the fuliginous wings resembling some of the modern Indian species, and like them, having the base distinctly pallid, though only for a short distance. The distance of the first recurrent nervure from the base of the second submarginal cell is an unusual feature, which I do not observe in living species

HOMOPTERA

Family CERCOPIDAE

PHILAGRA(?) KUDIANA, new species

Plate 1, fig. 3

Hind wing 18.5 mm. long, entirely fuliginous; r.–m. cross vein transverse (vertical), 6 mm. from apex of wing; m.–cu. cross vein strongly oblique, arched, its lower end apicad, about 0.6 mm. from fork of cubitus and a little over 7 mm. from end of upper branch of cubitus; cubital fork wide; second anal undulate, with a strong double curve.

Tertiary rocks of Kudia River, Amagu, Siberia.

Holotype.—Cat. No. 69602, U.S.N.M.

Philagra, a genus now ranging to China, Japan, and Australia, has exactly the same venation, but whether the fossil species had the produced head of *Philagra* we cannot know. *Aphrophora* differs by having the lower cross vein vertical, as I have verified by examining various species. *Cosmoscarta* has this cross vein oblique, but the lower end is basad. This fossil may be compared with *Aphrophora angusta* Handlirsch, from the Tertiary of Tulameen River, British Columbia. This species is quite as large as ours, but has a cu.–a. cross vein, and a much narrower cell between branches of cubitus.

APHROPHORA PROTOCALLA, new species

Plate 1, Fig. 6

Tegman 13.5 mm. long, 4 broad in middle (clavus missing; costal margin convex, but not excessively so; outer margin about

4 mm. long, gently curved, the apex of the tegmen obtuse, not pointed, apex and outer margin being formed as in the oriental *Thoodzata princeps* Distant, whereas in modern *Aphrophora* the tegmen is more pointed. Venation as in *Aphrophora*, with the radius curved, not straight as in *Thoodzata;* distance between branches of radius slightly greater than distance between lower branch and upper branch of media. Base of tegmen with the elongate-inclosed area above radius (formed by the subcosta) whitish, but the area between subcosta and costa dark-brown; below the radius the basal part of the tegmen is colorless, except for a very large obtusely cuneiform (pointed basad) mark through the middle of which runs the stem of the media; a very broad colorless band across tegmen 3.7 mm. from base, its outer margin reaching fork of media, its lower end narrowed; beyond this light band is a large brown area about 3 mm. long, its upper portion darkest, the principal veins remaining pale as they cross it; next, and about 8 mm. from base, is another transverse colorless band, very broad above, with an obtuse extension along lower branch of radius, below much narrowed, and ending in an extremely oblique band crossing lower branch of media, directed basad; next follows a brown band, shaped rather like the pale one, but abruptly bent apicad and very narrow on lower branch of radius; apical area pallid, apparently more or less brownish. The radius forks about 1.8 mm. beyond level of fork of media.

Tertiary rocks, Kudia River, Siberia.

Holotype.—Cat. No. 69603, U. S. N. M.

A very beautiful fossil, not satisfactorily separable from *Aphrophora*, but not like the European tertiary species assigned by Heer to that genus. Both shape and pattern recall the allied genus *Thoodzata* Distant, from Tenasserim.

MEGACERCOPIS, new genus

Tegmina large; costa only slightly arched; apex broadly rounded; lower margin (clavus present) straight: stem of radius directed obliquely upward, but no less than 3 mm. below costa, giving rise to a rather broad symmetrical fork, the upper branch passing some distance below costa, and at the end abruptly deflected downward to meet the radial sector, this being anterior to the similar curved vein connecting the sector with the media; media emitting four inferior branches to the margin, which appear as pale lines on a dark ground; Cu_2 (in sense of Tillyard) strong and straight; only the extreme tip of first anal preserved, this about 7 mm. anterior to end of Cu_2.

Type.—Megacercopis optima, new species.

MEGACERCOPIS OPTIMA, new species

Plate 1, fig. 4

Tegmen so far as preserved 19 mm. long, but the base (basad of separation of Cu_1+M from Cu_2) is lacking, and the total length would probably be about 23 mm.; width 7.3 mm.; fork of radius 14.6 mm. from apex; tegmen pale, with dusky spots and patches; area above stem of radius suffusedly dusky; a dusky shade or line (only well defined outwardly) crossing the tegmen beyond level of fork of radius, receding basad at upper branch of radius (but not at sector), at media and at cubitus, between media and cubitus forming a semicircular mark; a small spot just below Cu_2 near base; just beyond level of end of Cu_2 are three large elongate patches, the first between branches of radius, the second between radial sector and media, and the third just beyond and narrowly connected with the semicircular mark already described; just beyond the third of these patches is another, through which runs a white line, bent beyond the middle; in subapical region, bounded by vein connecting radial sector with media, is a large oblong patch; margin of nearly apical third of tegmen brown, the interrupting veins appearing white.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69604, U.S.N.M.

Scudder in 1895 remarked on the large size of the Cercopinae of the tertiary of British Columbia. The present insect shows some resemblance in its markings to *Dawsonites veter* Scudder, from the British Columbia Tertiary, but the structure differs. In venation, our genus suggests Scudder's *Stenecphora*, but the shape of the apical part is quite different.

The present Cercopid fauna of northern regions (about 25 species in America north of Mexico) is an impoverished remnant of the Cercopidae of tertiary time.

Family CICADELLIDAE

LAVRUSHINIA, new genus

Tegmen (clavus missing in type specimen) long and narrow, costa practically straight, apex broadly and symmetrically rounded; media leaving radius before end of basal third, the fork symmetrical and rather wide; large discoidal cell between media and radius elongated, squarely truncated at the beginning of the middle anteapical cell, but above narrowly contiguous with the cuneate base of the cell in the radial fork, and below more broadly with the large cell in the fork of the media, this last cell being truncate apically, but cuneate basally, with a very long oblique side on cell

between media and cubitus; the usual upright cross-vein (supposedly end of subcosta) from upper subapical cell; the usual three rather short (but longer than high) apical cells, truncate basally, the middle one not extending so far basad as the others; cubitus straight; a broadly lanceolate cell beyond its end, at the anal corner, contiguous for an equal distance with the lower subapical and lower apical cells; marginal vein hardly separate from margin, except narrowly at the anal angle. I follow Tillyard's nomenclature, but the ambient vein, which he describes as specially characteristic of Membracidae, also exists in Cicadellidae, and sometimes is quite evidently separated from the margin.

Type.—Lavrushinia elegantula, new species.

I am at a loss to identify this with any modern genus. The venation varies so much within the genus in this family (as in *Deltocephalus*), that the tegmen alone is not very satisfactory for generic determination, but it seems probable that we have to do with an extinct genus. There is some resemblance to such genera as *Tettigoniella* and *Helochara*. *Chunra* of Distant differs at once by having the ambient vein widely separated from the margin, as Tillyard describes for the Membracidae.

LAVRUSHINIA ELEGANTULA, new species

Plate 1, fig. 2

Tegman 6.5 mm. long, 2 broad (clavus missing); dilute fuliginous, with strong brown veins, costal margin dark, and stigmatic region infuscated.

Tertiary of Kudia River, Siberia. Found by Mr. A. I. Laxrushin, after whom the genus is named.

Holotype.—Cat. No. 69605, U.S.N.M.

Family CIXIIDAE

MUNDOPOIDES, new genus

Resembling the oriental genus *Mundopa* Distant, but with nearly straight costa, obliquely truncate apex and almost straight outer margin, giving the tegmen a very mothlike aspect. A sharp, simple subcosta running just below the costa, ending on margin about middle of tegmen; radius running about a third of depth of tegmen below costa, a little before middle of wing emitting two long very oblique branches above; apical area, beyond the second pale band, with widely separated, not dense, longitudinal veins. Clavus missing in the type. The tegmen is black, with two broad light bands, as in the Cercopids *Tomaspis* and *Cosmoscarta*, but the structure is not that of Cercopidae. The outer margin is very narrowly pale, as in *Ciocixius*.

Type.—Mundopoides cisthenaria, new species.

MUNDOPOIDES CISTHENARIA, new species

Plate 1, fig. 5

Tegmen about 11 mm. long (the extreme base lacking); black, with two broad colorless bands; the first, not far from base, about 1.5 mm. wide, suddenly and rectangularly constricted at inner lower corner; the second, about 1.7 mm. wide, gently arcuate, placed 3 mm. beyond the first band, and 4 mm. from apex; apical margin very narrowly pallid. A round spot and a pale patch, with other slight markings, are not natural, but due to abrasion. The second band does not quite reach the costa at its upper outer corner, but on the inner side appears to be prolonged along costa; costa hardly arched; outer margin little curved, 5 mm. long; lower margin straight (in absence of clavus), at least 9 mm. long.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69613, U.S.N.M.

The name of the species is derived from a superficial resemblance to the moths of the Neotropical genus *Cisthene;* the central band is placed nearly as in *C. lunaris* Walker. The shape of the tegmen recalls the Ricaniine genus *Privesa*, but the structure is quite different. There is a genuine resemblance to the American genus *Bothriocera*, species of which have a somewhat similar pattern of light and dark markings.

DIPTERA

Family BIBIONIDAE

Genus PLECIA Wiedemann

The genus *Plecia* is very widely distributed over the world, but in any given fauna the species are few. It therefore seemed quite scandalous for Handlirsch to describe 20 species from tertiary rocks in two localities in British Columbia, there being only about three to-day in the whole of the Nearctic region. However, I have been able to distinguish four readily separable species in the Florissant Miocene, and in now presenting 6 from a single Siberian locality I believe I err, if at all, on the side of moderation. I do not yet believe that all of Handlirsch's 20 species are distinct, but it must apparently be recognized that in tertiary times *Plecia* was very rich in species, as *Tipula* is to-day, and indeed was then.

Brunetti, in his table of Indian *Plecia*, divides the species into two categories thus: (*a*) Third (3+4) longitudinal vein forking some distance beyond anterior cross vein (nearly at half the length of its lower branch), and always distinctly beyond the fork of fourth vein. (*b*) Third longitudinal vein forking shortly beyond anterior cross vein (distinctly before one-third of the length of its

lower branch), and approximately opposite the fork of fourth vein; the upper branch lying almost parallel to the lower one, not almost erect as in the other division.

Divided thus, only one Siberian species (*P. amagua*) falls in division *b*. The remaining five go in *a*, except for the fact that the upper branch (second vein) is not short and suberect as in *P. fulvicollis*. In the modern Indian fauna, the preponderance is the other way, division *b* having three species, division *a*, only two. The common American *P. heteroptera* Say falls in division *a*, but has the upper branch (second vein) long and running nearly parallel with the lower, thus more resembling the majority of Siberian fossils than do the Indian members of this division. *P. plagiata* Wiedemann, from Guatemala, has the upper branch even more erect than in *P. fulvicollis*. It would appear that this erect or suberect branch is a character of the tropical species of both hemispheres, or at least, is lacking in those of temperate regions.

The Siberian fossils may be separated thus:

Wing less than 6 mm. long ..... 1.
Wing over 6 mm. long ..... 2.
1. Cell in fork of vein 3 (2+3) very long and narrow ..... **amagua**, new species.
Cell in fork of vein 3 shorter and broader ..... **kudiella**, new speces.
2. Basal corner of second posterior cell at a distance from anterior cross vein less (or not more than) the length of cross vein ..... **refracta**, new species.
Basal corner of second posterior cell at a distance from anterior cross vein greater than length of cross vein ..... 3.
3. Third vein before anterior cross vein over 2 mm. long ..... **redempta**, new species.
Third vein before anterior cross vein less than 2 mm. long ..... 4.
4. Upper branch of fourth vein nearly in line with stem ..... **kuznetzovi**, new species.
Upper branch of fourth vein strongly and abruptly elevated at base.
obsitula, new species.

In this key the living *P. heteroptera* runs straight to *P. refracta*. In the descriptions, I follow Williston's interpretation of the venation, but as shown below, this may be incorrect in respect to the second vein.

PLECIA AMAGUA, new species

Plate 2, fig. 15

Wing 5.5 mm. long and about 2.3 broad, very pale reddish, with pale veins; fork of third vein extremely narrow, the upper part (second vein) very weak, the lower strong and strongly curved; fork of fourth vein at a distance from anterior cross vein considerably greater than length of latter; fork of third vein a little before vertical level of fork of fourth. Anterior cross vein to fork of fourth 480 μ.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69606, U.S.N.M.

Related to *P. atra* Brunetti, but with the fork of third vein even narrower, in its basal portion less than half width of fork of fourth. The fourth posterior cell is greatly widened on the margin; in this respect *P. amagua* differs from *P. atra* and resembles rather *P. fulvicollis*.

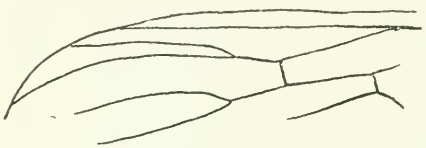


FIG. 4.—PART OF VENATION OF PLECIA AMAGUA

PLECIA KUDIELLA, new species

Plate 2, fig. 18

Wing about 5 mm. long. Differs from *P. amagua* by being smaller, with vein 3 much less curved downward at end, and the fork (separation of 2 from 3) much shorter and more open, its base considerably beyond vertical level of fork of fourth. The wing is very pale, faintly reddish, with pale veins. The fork of fourth vein is wide, its base about 320 μ. from anterior cross vein, the latter being about 160 μ long. The fourth posterior cell is little widened apically, being about as in *P. atra*.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69607, U.S.N.M.

PLECIA REFRACTA, new species

Plate 2, fig. 21

Wing 9.6 mm. long, 3.8 wide; moderately dusky throughout, with pale veins. Upper branch of third vein (second vein) colorless and difficult to see; fork of fourth vein to anterior cross vein about 430 μ, the anterior cross vein about 480 μ long; anterior cross vein more than twice as far from base of third posterior cell as from fork of fourth vein; fork of third vein very far beyond vertical level of fork of fourth, being about 1280 μ beyond anterior cross vein; fourth posterior cell wide open at apex.

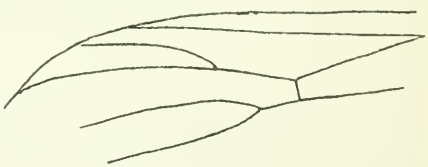


FIG. 5.—PART OF VENATION OF PLECIA KUDIELLA

Tertiary of Kudia River, Siberia. In addition to the type, four other specimens are referred to this species.

Holotype.—Cat. No. 69608, U.S.N.M.

PLECIA REDEMPTA, new species

Plate 2 fig. 20

Wing about 8.6 mm. long, dusky, with the upper part fuliginous, the veins dark. This resembles *P. obsitula*, but is distinct by the much longer third (really second and third united) vein before anterior cross vein, the length of this section being 2320 μ (in *obsi-*

tula only 1470 μ.) The second posterior cell (fork of fourth vein) is also much wider, the width about middle 1200 μ (in *obsitula* 800 μ). Anterior cross vein to fork of third, about 1280 μ; to fork of fourth about 590.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69609, U.S.N.M.

PLECIA KUZNETZOVI, new species

Plate 2, fig. 19

Wing 7 mm. long; differs from *P. obsitula* in being smaller, paler, with upper branch of fourth vein nearly in a line with stem (in *obsitula*, *redempta*, and *refracta* it is abruptly elevated at base), and second vein after separation from third nearly parallel with the latter. The third vein before anterior cross vein is 1.4 mm.; fourth posterior cell widely open at apex; anterior cross vein only about half as long as in *P. redempta*, its distance from fork of fourth about 430 μ.

Tertiary of Kudia River, Siberia.

Holotype.—Cat. No. 69610, U.S.N.M.

Under a lens, it looks as if the second vein came from the first, but this is quite illusory, being due to a clouding of the wing at this point. The species is named after the discoverer of the deposit.

PLECIA OBSITULA, new species

Plate 2, fig. 17.

Wing 8.3 mm. long, 3.4 wide, dusky, with mainly dark veins, the costal region broadly suffused with fuliginous; fork of fourth vein distant from anterior cross vein nearly 1.5 times the length of cross-vein; cross vein slightly beyond midmost point between separation of third vein and its fork; anterior cross vein conspicuously closer to fork of fourth than to base of third posterior cell, but not nearly twice as close; fourth posterior cell widely open at apex; anterior cross vein to fork of third twice as far as to fork of fourth; upper branch of third (really second) vein abruptly elbowed at base. The type appears to be a male; two specimens with broader and paler wings are presumed to be females, the sexual difference being as in modern species.

Tertiary of Kudia River, Siberia. In addition to the type specimen, six others are referred to this species.

Holotype.—Cat. No. 69611, U.S.N.M.

In *Protoplecia*, from the Upper Lias of Mecklenburg, the fork of third vein is far anterior to the vertical level of fork of fourth, which would seem to indicate that the condition observed in *P. amagua* is the more primitive. From the same European deposit,

however, Handlirsch has more recently published a genus *Eoplecia*, in which the third vein of Williston (radical sector) emits two branches above, one before, the other after, the anterior cross vein. Thus it may be held that the second vein is actually absent in the modern insect, and not represented by the upper branch of the third. This view is further supported by the condition in the Anisopodidae, in which the second vein arises before the cross vein, and the third is without a fork. In such Diptera as the Leptidae, the second vein arises as in Anisopodidae, but the third forks in a manner analogous to that of *Plecia*. Brunetti, however, argues that possibly it is the third vein which is absent in Bibionidae, and says:

> If we compare a wing of *Culex* with that of *Plecia*, and simply eliminate the third vein from the former and lengthen the anterior cross vein, we get an exact counterpart in the wing of the latter.

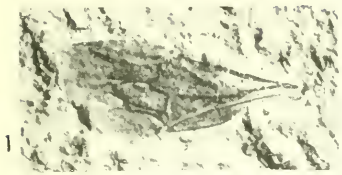
EXPLANATION OF PLATES.

PLATE 1.

FIG. 1. *Megachile amaguensis*, new species, × 3½.
2. *Lavrushinia elegantula*, new species, × 6.
3. *Philagra* (?) *kudiana*, new species, × 3.
4. *Megacercopis optima*, new species, × 2½.
5. *Mundopoides cisthenaria*, new species, × 3.
6. *Aphrophora protocalla*, new species, × 2½.
7. *Anthonomus amaguensis*, new species, × 6.
8. *Throscus* (?) *peritulus*, new species, × 6.
9. *Limnephilus recultus*, new species, × 3.
10. *Patrobus* (?) *kudiensis*, new species, × 6.
11. *Cleonus shareipoffi*, new species, × 6.

PLATE 2.

FIG. 12. *Indusia comminuta*, new species, × 6.
13. *Indusia sequoiae*, new species, × 3.
14. *Amagupsyche perlata*, new species, × 2.
15. *Plecia amagua*, new species, × 6.
16. *Phryganea lavruschini*, new species, × 2.
17. *Plecia obsitula*, new species, × 6.
18. *Plecia kudiella*, new species, × 6.
19. *Plecia kuznetzovi*, new species, × 6.
20. *Plecia redempta*, new species, × 6.
21. *Plecia refracta*, new species, × 3.



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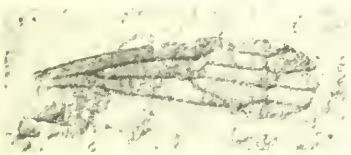

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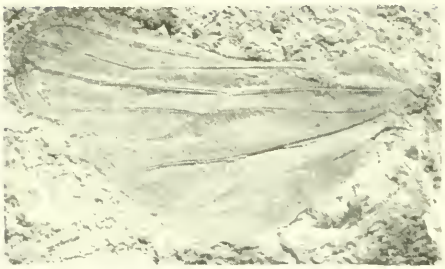

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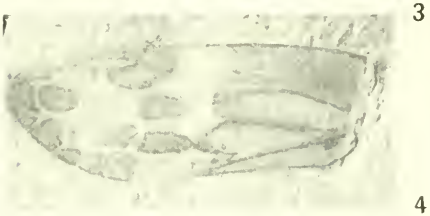

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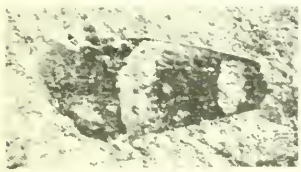

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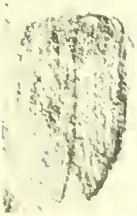

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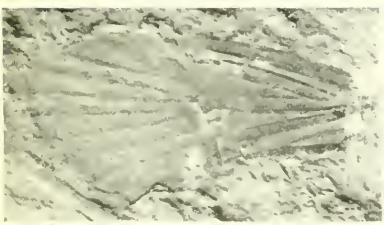

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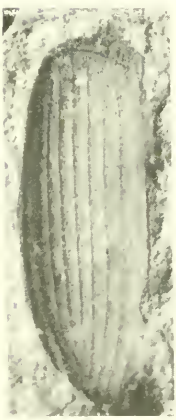

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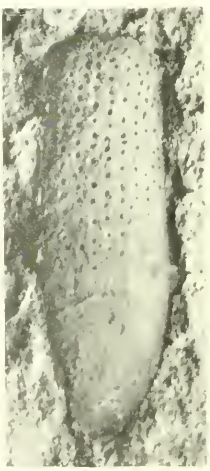

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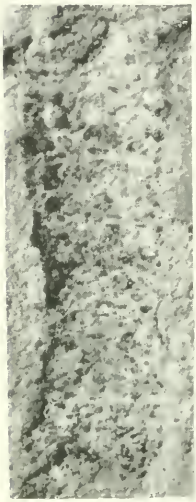
TERTIARY INSECTS FROM KUDIA RIVER, SIBERIA

FOR DESCRIPTION OF PLATE SEE PAGE 16



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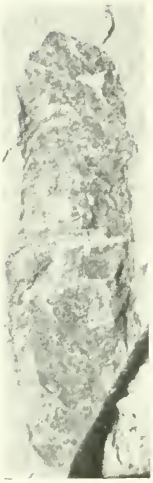

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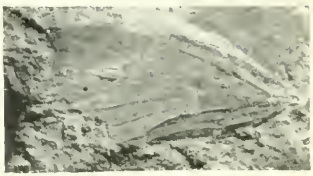

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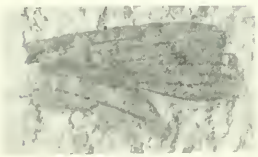

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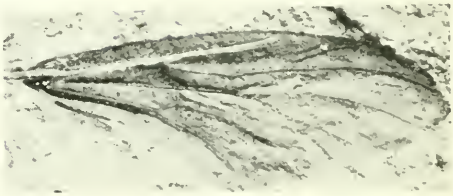

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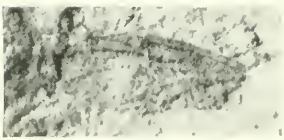

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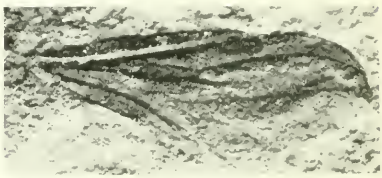

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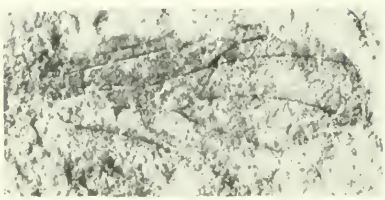

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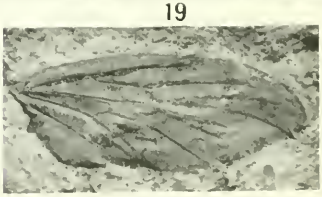

21

TERTIARY INSECTS FROM KUDIA RIVER, SIBERIA

FOR DESCRIPTION OF PLATE SEE PAGE 16

SOME HALICTINE BEES FROM THE MARITIME PROVINCE OF SIBERIA

By T. D. A. Cockerell

Of the University of Colorado, Boulder

The genus *Halictus* is world-wide, with an enormous number of species, many of which are very closely allied and hard to discriminate. The reason for this specific diversity is not wholly apparent, as the insects are much less restricted to particular flowers and seasons than the species of *Andrena*. From Europe we know at present about 128 apparently valid species. The number would be considerably greater were it not for the synonymy recently proposed by Dr. P. Blüthgen, based on his intensive studies. It may be that he has gone too far in reducing names to the synonymy, but it must be admitted that previous authors have proposed many needless names.[1] Errors have been difficult to avoid, partly because adequate collections were not available, and it is by no means easy to describe the pecularities of form and sculpture in a perfectly intelligible manner. Some future monographer will perhaps illustrate the form of the head, sculpture of the thorax, etc., by enlarged photographic figures, and thus place the whole subject on a much sounder basis. It will also be desirable to figure the mouth parts and male genitalia.

Many of the European species extend into Asia, either as local races or subspecies, or in some cases practically unmodified. Turkestan has an extensive fauna of about 47 supposedly endemic species, but these are poorly represented in museums and rather insufficiently known. I possess specimens of *H. equestris* Morawitz, *cariniventris* Morawitz, and *variipes* Morawitz, but the latter two are now considered synonymous with *H. mucoreus* Eversmann (*pollinosus* Sichel) and *H. subauratus* Rossi, respectively. This Turkestan fauna belongs to a dry country, and has very little in common with that of the moist coast region of southeastern Siberia, where my collecting was done. The insects of the Maritime Province are to be compared with those of Europe rather than with those of Turkestan or Mon-

[1] Blüthgen (in litt.) suggests that my *H. bentoni*, from Persia, is *H. obscuratus* Morawitz, described from Turkestan.

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53653—25——1

golia, and there is only a small infusion of oriental types from the south.

From other parts of temperate Asia the *Halictus*-fauna is very imperfectly known, so it is not surprising that most of the species collected in the Maritime Province appear to be new. The remarkable *H. dybowskii* Radoszkowski, described from the region of the Amur, was also obtained by me and I have referred it to a new genus *Acanthalictus*, along with a closely related new species (*A. griseipennis* Cockerell). *H. denticollis* Morawitz, from Eastern Siberia, I did not find. *H. monstrificus* Morawitz, from Siberia, is said by both Alfken and Blüthgen to be *H. sextrigatus* Schenck. *H. rufitarsis* Zetterstedt, which Strand records as collected by Eschscholtz in Kamtchatka, was not recognized in the Maritime Province, nor could I identify any of my specimens with the species described by Strand from Tsingtau, in China.

Of the 128 European species, I possess only 54, and these have all been carefully compared with the Siberian material. It is, of course, possible that among the species I have not seen and could not properly interpret from the descriptions alone there may be some of those here described as new, but I think it is unlikely. The very widespread species are, as a rule, the better-known ones, although it occasionally happens that a rare and little-known form will turn up in very remote localities. It is very likely that some of the species now described will be found in Sakhalin Island or northern Japan, but I can not identify any of them with known Japanese species.

The present report does not deal with the subgenera *Seladonia* and *Chloralictus*, but it is worth while to note that I found only one *Chloralictus*, the new *H. mayacensis* Cockerell from Low Lighthouse, and two species of *Seladonia*, the European *H. tumulorum* linnaeus and the new *H. cruditus* Cockerell.

HALICTUS MOLTRECHTI, new species

Female.—Length about 7.5 mm., anterior wing 6 mm.; black, shining, rather robust, with scanty pubescence; head broad, about circular seen from in front, face and occiput with thin pale hair; clypeus produced, polished, with well-separated strong punctures; supraclypeal area entirely different, with minute punctures; front dull above, but shining along the sides and near the antennae; antennae entirely black; cheeks rounded, not enlarged; mesothorax and scutellum shining, well and distinctly punctured; scutellum with a median groove; hair of thorax scanty, tinged with brownish, fringe on tubercles comparatively short (a point of distinction from *H. calceatus* Scopoli); area of metathorax with distinct but irregular (wavy and bent) longitudinal rugae; the posterior limit of area

well defined; posterior truncation dullish, and with thin reddish hair, the lateral margins very sharply defined; tegulae dark rufous; wings dusky, stigma and nervures dusky amber; basal nervure close to nervulus; second cubital cell very broad, receiving recurrent nervure well before end; outer intercubitus and recurrent weakened; legs with pale reddish hair, becoming golden on inner side of hind tarsi; hind spur pectinate, with three spines; abdomen broad, highly polished, minutely punctured, hind margins of segments rather obscurely brown; thin inconspicuous hair patches at lateral bases of second and third segments.

Okeanskaja, Siberia, August 5, 1 female (Cockerell).

Type.—Cat. No. 27338, U.S.N.M.

Superficially very closely resembles *H. interruptus* Panzer, of Europe, but certainly distinct by the lack of a transverse groove on clypeus, and the much better defined and more distinctly sculptured area of metathorax. The posterior truncation of metathorax is sparsely and weakly punctured, with a little irregular striation at the extreme top; in *H. interruptus* it is conspicuously striate or plicate all over. The hind tibial spur of *H. interruptus* is coarsely pectinate, much as in the Siberian species.

Named after Dr. A. Moltrecht, the learned lepidopterist of Vladivostok.

HALICTUS KRALOFFI, new species

Female.—Length about 7 mm., anterior wing 5.5 mm.; similar to *H. moltrechti*, but smaller, and differing also as follows: Face narrower; disk of mesothorax more closely punctured, and with a distinct median groove; area of metathorax more closely sculptrued, the rugae variously incomplete and forming an irregular network; second cubial cell narrower; abdomen narrower, basal hair-band white and complete at least on second segment; hind spur pectinate with at least five rather short teeth; margin of second abdominal segment more conspicuously pale; hair on inner side of hind tarsi paler, less golden; hair fringe of tubercles white (tinged with reddish in *H. moltechti*). The tegulae are rufous.

Kongaus, Siberia, August, 1 female (Cockerell).

Type.—Cat. No. 27339, U.S.N.M.

Certainly very close to *H. moltrechti*, but surely a distinct species. There is a very close general resemblance to *H. opacus* Pérez, from Corsica, but that species differs by the strongly reddened wings, much broader second cubital cell, and closely and very finely punctured apical part of first abdominal segment.

Named after Nicolai Petroivich Kraloff, of the Vladivostok Museum, who has collected many bees in the Maritime Province.

HALICTUS SOLOVIEFFI, new species

Female.—Length about 7.5 mm., anterior wing 5.4 mm.; superficially so much like *H. kraloffi* that I took it for the same, but it differs as follows: Tegulae piceous; mesothorax dullish (without polished surface), very closely and rather coarsely punctured; rugae of metathoracic area fewer and not forming a network. In *H. kraloffi* the disk of the mesothorax has the small punctures separated by, on the average, considerably more than a puncture's width; in this form the punctures are large and dense, separated by hardly half a puncture's width, and the intervals are sculptured. The hind margins of the second and following abdominal segments are pallid, those of the third and fourth quite broadly so; and there are no conspicuous basal hair bands. The hind spur is long-pectinate. The short fringe of the tubercles, and smaller size, readily separate it from *H. calceatus* Scopoli.

Kongaus, Siberia. August 9, female (Cockerell).

Type.—Cat. No. 27340, U.S.N.M.

Named after Nicolas Solovieff, of the Vladivostok Museum, who has maintained a center for zoological work and education in spite of difficulties of many kinds, and deserves the good wishes and thanks of all scientific men.

The following table separates a series of moderately large black females of *Halictus* from the Maritime Province of Siberia:

Mesothorax highly polished, sparsely punctured, and with a sharp edge in front (Kongaus and Okeanskaja)---------- morbillosus orientis Cockerell.
Mesothorax dull, or if shining, closely or rather closely punctured---------- 1
1. Large species, with hair-bands at apices of segments; third cubital cell more than twice as long as second, the second not particularly narrow; wings strongly reddened (Okeanskaja)---------- tetrazonius Klug.
Third cubital cell not nearly twice as long as second, or if so, second very narrow, and species relatively small---------- 2
2. Apical part of first abdominal segment polished, little or not punctured-- 3
Apical part of first abdominal segment conspicuously punctured---------- 6
3. Tubercles with a very long fringe; wings dusky; head not circular (Okeanskaja)---------- calceatus Scopoli.
Tubercles with a relatively short fringe---------- 4
4. Larger; head circular---------- moltrechti, new species.
Smaller; head narrower---------- 5
5. Tegulae dark; mesothorax densely punctured---------- solovieffi, new species.
Tegulae red; mesothorax shining and more sparsely punctured.
kraloffi, new species.
6. Larger; second cubital cell broad (Kongaus)---------- tacitus Cockerell.
Smaller; second cubital cell narrow (Okeanskaja, Olga, Amagu village, Kudla River)---------- alinensis Cockerell.

The last is closely related to *H. leucozonius* Schrank.

HALICTUS LUTZENKOI, new species

Male.—Length about 8 mm., anterior wing 5.7 mm.; black, with white hair, long and pale fulvous in region of scutellum; head broad, circular seen from in front; cheeks moderately swollen, rounded; face and front densely covered with white hair; clypeus not much produced, with an apical transverse yellowish-white mark; antennae long, entirely black, flagellar joints submoniliform; mesothorax and scutellum polished, with distinct but not very close punctures; area of metathorax shining, with strong longitudinal rugae; posterior truncation sharply defined, and with conspicuous transverse rugae; tegulae large, very dark brown with broad whitish margins; wings grayish hyaline, stigma and nervures dusky yellowish; second cubital cell narrow, hardly half as broad as third, receiving recurrent nervure a little before end; outer nervures not distinctly weakened; legs entirely black, with light hair, spurs pale ferruginous; abdomen shining, finely punctured, conspicuous and entire white basal hair-bands on segments 2 to 4; venter of abdomen with a patch of pale red hair subapically.

Okeanskaja, Siberia, August 18, 1 male (Cockerell).

Type.—Cat. No. 27341, U.S.N.M.

Apparently nearest to *H. zonulus* Smith, but differing sufficiently in sculpture and venation to be separable. In Crawford's table of North American species it runs close to *H. similis* Smith. I had supposed *H. similis* to be inseparable from *H. leucozonius*, but the male, as determined by Crawford, is certainly not *leucozonius*. Crawford himself remarks that it is what I regard as *H. discus* Smith.

Named after the able director of the Commercial School at Vladivostok, who has done much to stimulate scientific interest among his pupils.

HALICTUS WITTENBOURGI, new species

Male.—Length about 8 mm., anterior wing 6.7 mm.; black with white hair, on head and thorax above distinctly tinged with yellow; head broad, but face rather narrow, and clypeus strongly produced, its apical margin with a broad pale yellow band; cheeks flattened, not prominent; antennae black, reaching quite to end of scutellum; mesothorax and scutellum dull and rugosopunctate, the mesothorax anteriorly rather densely clothed with short pale hair, on a surface which is punctured as closely as possible; area of metathorax poorly defined, coarsely rugose; posterior truncation sharply defined, strigato-rugose; tegulae dull rufous, piceous at base; wings grayish-hyaline, stigma and nervures reddish-brown, stigma ending more obtusely than usual; second cubital cell broad, receiving recurrent nervure near end, third not very much broader than second; abdo-

men dull and glaucous, finely punctured, conspicuous entire white hair-bands at bases of segemnts 2 to 4; two tufts of reddish hair beneath near apex; legs black, with light hair; spurs white.

Kongaus, Siberia, August, 1 male (Cockerell).

Type.—Cat. No. 27342, U.S.N.M.

Compared with *H. sexnotatus* Kirby, this differs at once by the dull abdomen, sharply margined truncation of metathorax, more produced and apically narrower clypeus, more slender flagellum, etc. The metathorax is more like that of *H. major* Nylander, but the abdomen is totally different. In the North American fauna it recalls *H. trizonatus* Cresson, which also has a glaucous abdomen, but other characters differ greatly.

Named after Dr. Paul de Wittenbourg, author of an extremely valuable account of the geology of the region about Vladivostok, who rendered our expedition many invaluable services. I considered the possibility that this might be the male of *H. tacitus* Cockerell, but on comparison was obliged to reject this hypothesis.

HALICTUS SHISHKINI, new species

Male.—Length about 6.5 mm., anterior wing 5.4 mm.; black, with rather thin white hair, not at all tinged with yellow on thorax above; head broad, but inner orbits subemarginate, and eyes strongly converging below; face and front with white hair; clypeus with a large pale yellow patch, sending a median process upward; labrum yellow; mandibles pale yellow in middle and rufous apically; antennae black, reaching to the end of thorax, flagellum stout; a polished space in front of anterior ocellus; mesothorax shining, rather closely and quite distinctly punctured; scutellum coarsely rugosoplicate; area of metathorax well defined, with about sixteen vermiform rugae; posterior truncation well defined, and with a series of lateral pits; pleura rugose; tegulae clear rufous; wings hyaline, stigma and nervous light ferruginous; second cubital cell rather narrow, but much more than half width of third, receiving recurrent nervure well before end; outer nervures somewhat weakened; legs black, with knees, anterior tibiae in front, all tibiae at both ends, and tarsi, creamy-white, more reddened on front tibiae; spurs white; abdomen long and slender, highly polished, with very minute punctures; no hair-bands or spots; hind margin of second segment narrowly reddened; no subapical ventral tuft of reddish hair. The tubercles have a small light spot.

Kongaus, Siberia, August, 1 male (Cockerell).

Type.—Cat. No. 27343, U.S.N.M.

Something like *H. fulvicornis* Kirby, but at once separated by the shining mesothorax and dark antennae. In the American fauna it

falls near *H. aberrans* Crawford. The long antennae recall *H. rufocinctus* Sichel.

Named after J. K. Shiskin, the accomplished botanist of Vladivostok.

HALICTUS EMELIANOFFI, new species

Male.—Length about 8 mm., anterior wing 6 mm.; black, with white hair, tinged with yellow on head and thorax above; face broad; clypeus with a broad transverse apical white band; labrum brown; mandibles black, ferruginous subapically; antennae reaching about to scutellum; flagellum ferruginous beneath; mesothorax and scutellum shining but quite closely punctured; area of metathorax large, with closely set longitudinal rugae, but a transverse polished smooth band apically; posterior truncation distinctly defined, shining, without strong sculpture, but rugose at sides; tubercles entirely black; tegulae large, pale rufotestaceous, piceous at base; wings hyaline, faintly grayish; stigma large, deep rufofuscous; nervures fuscous; basal nervure quite distant from nervulus; second cubital cell narrow, receiving recurrent nervure before the end; third cubital not twice as broad as second; outer nervures hardly weakened; anterior tibiae in front very pale reddish; middle and hind basitarsi yellowish white; small joints of tarsi dusky; all the tibiae reddish at extreme base and apex; spurs white; abdomen narrow, shining, finely punctured; dull white bands of tomentum, failing in middle, at bases of segments 2 to 4; tip of abdomen rufous; no subapical ventral tuft of red hair.

Okeanskaja, Siberia, August 18, 1 male (Cockerell).

Type.—Cat. No. 27343, U.S.N.M.

This insect is rather suggestive of *H. laevis* Kirby, but the color of the tegulae and wings and the details of sculpture are conspicuously different, so that there is perhaps little real affinity. The hind margins of the abdominal segments are obscurely brownish, but not reddish as in *H. laevis*. In Crawford's table of American species it runs to *H. arcuatus* Robertson, but is not allied.

Named after Alexander Adrianovich Emeljanoff, of Vladivostok, keen student of the herpetology of the Maritime Province.

The following table separates a series of black male *Halictus* collected in the Maritime Province:

Basitarsi black	1
Basitarsi pale	3
1. Nervures fuscous; second cubital cell nearly as broad as third.	wittenbourgi, new species.
Nervures testaceous; second cubital cell very narrow	2
2. Mesothorax closely punctured (Kongaus)	alinensis Cockerell.
Mesothorax sparsely punctured on disk, polished	lutzenkoi, new species.
3. Antennae very long; face narrower	shishkini, new species.
Antennae moderate; face broader	emelianoffi, new species.

In the Amagu region, in July, the males had not begun to appear, but in the southern part of the Province, in August, they were appearing in small numbers before we left. The females of the same species probably emerged a little later, so that of five kinds of males we have only the female for one.

The small black species of *Halictus* collected in the Maritime Province of Siberia, belonging to the subgenus *Evylaeus* Robertson, are referable to two series, separated by the hind spur of the female.

GROUP A, HIND SPUR OF FEMALE HIND TIBIA WITH NUMEROUS (USUALLY ABOUT SIX) RATHER SHORT OBLIQUE SPINES

HALICTUS TRANSPOSITUS, new species

Female.—Length nearly 6 mm., anterior wing 5 mm.; black, with scanty grayish-white hair; hind margins of abdominal segments rather broadly pale reddish; abdomen without any conspicuous hair bands or patches, but a little pale hair at lateral bases of second segment; head broad, approximately circular seen from in front; mandibles obscurely reddish subapically; clypeus shining, with strong punctures; sides of face glistening, front dull; flagellum dull ferruginous beneath except basally; thorax robust; mesothorax and scutellum polished, distinctly but not very densely punctured; median depressed line on mesothorax distinct, but none on scutellum; sides of thorax dull, except a shining area below the wings; area of metathorax large, with fine but distinct longitudinal plicae, not nearly reaching the apex; posterior truncation with the sides sharply margined only halfway up; tegulae bright ferruginous; wings dusky hyaline; nervures pale testaceous; stigma large, pale rufo-testaceous; basal nervure a considerable distance from nervulus; second cubital cell not very much narrower than third, receiving recurrent nervure at apex; legs black, with pale hair, small joints of tarsi rufescent, hind femora red at extreme apex; abdomen broad, shining, the broad hind margins of segments polished. Hind spur with at least six short teeth or spines.

Kongaus, Siberia, August, 1 female (Cockerell).

Type.—Cat. No. 27345, U.S.N.M.

Related to *H. intermedius* Schenck. *H. semilucens* Alfken is readily separated by the dark-brown stigma.

HALICTUS TUTIHENSIS, new species

Female.—Length nearly 6 mm., anterior wing 5 mm.; black, with very scanty whitish pubescence; hind margins of abdominal segments narrowly but distinctly rufescent; head broad; mandibles with apical half dark rufous; clypeus shining and strongly punctured; front slightly shining; flagellum with apical half obscurely reddened beneath; mesothorax and scutellum polished, finely punc-

tured; median depressed line of mesothorax distinct, a trace of one on scutellum; sides of thorax dull, except a shining area beneath wings; area of metathorax large, with fine longitudinal plicae; tegulae ferruginous; wings reddish hyaline, stigma clear amber, nervures dusky testaceous; basal nervure quite a distance from nervulus; second cubital cell much narrower than third; recurrent nervure meeting second intercubitus; legs black, with small joints of tarsi rufescent; abdomen shining, a little white hair at lateral bases of second and third segments. Hind spur with six short spines.

Tutihe, Siberia, July 14, 2 females, type locality (W. P. Cockerell); Kudia River, July 2, female (Cockerell).

Type.—Cat. No. 27346, U.S.N.M.

This greatly resembles the European *H. pauxillus* Schenck, but that species has a hind spur with a stout basal tooth, followed by four successively smaller rounded laminae, an arrangement quite different from that of any of the Siberian forms.

HALICTUS SUPRAFULGENS, new species

Female.—Length nearly 7 mm., anterior wing 5.3 mm.; black, robust, hind margins of abdominal segments only very narrowly reddish; hair of head and thorax thin and dull whitish, but long and rather abundant on scutellum and pleura; head very broad; mandibles slightly reddish apically; clypeus shining, sparsely punctured; front slightly shining; mesothorax and scutellum shining, distinctly punctured, scutellum broadly depressed in middle; sides of thorax dull and rough, no shining area below wings; area of metathorax sharply defined, polished and shining, with imperfect and irregular basal plicae; posterior truncation shining, the lateral edges complete; tegulae rufous; wings dusky hyaline, slightly reddish; stigma dull reddish, nervures pale but dusky; basal nervure close to nervulus; second cubital cell conspicuously contracted above, receiving recurrent nervure before end; outer nervures weakened; abdomen highly polished, the punctures very small and weak; bases of segments 2 to 4 with broad conspicuous bands of white tomentum, narrowed or failing in middle.

Okeanskaja, Siberia, August 5, 1 female (Cockerell).

Type.—Cat. No. 27347, U.S.N.M.

HALICTUS SULCATULUS, new species

Female.—Length nearly 6 mm., anterior wing 5.2 mm.; black, robust, with scanty grayish-white hair; head rather broad oval; mandibles black, faintly reddish at tip; clypeus somewhat produced, shining, irregularly, and rather closely punctured; front somewhat shining, very densely punctured; antennae black, the flagellum obscurely reddish beneath apically; mesothorax and scutellum shining,

closely and distinctly punctured, median depressed line of mesothorax and scutellum distinct; entire mesopleura shining; tegulae black, reddish outwardly, but the whole effect extremely dark; wings strongly grayish, stigma dark brown, nervures lighter, outer nervures weakened; basal nervure near to nervulus; second cubital cell very broad below, narrowed above, receiving recurrent nervure near its end; third cubital not very greatly broader than second; legs black, including small joints of tarsi, hind basitarsi with pale red apical tuft; hind spur with at least six small spines; area of metathorax large, plicate basally, not polished; posterior truncation shining; abdomen very broad, hind margins of segments hardly perceptibly brownish; surface shining, no distinct hair-bands or spots, hind margins of segments 2 to 4 laterally with thin long pale hair.

Okeanskaja, Siberia, type locality, August 18, 5 females (Cockerell).

Paratype.—Cat. No. 27348, U.S.N.M.

The tegulae vary to rufous. One specimen was taken at the Kudia River, July (W. P. Cockerell).

GROUP B. HIND SPUR OF FEMALE HIND TIBIA WITH THREE LARGE, STOUT, WIDELY SPACED SPINES OR TEETH

HALICTUS PERPLEXANS, new species

Female.—Length about 5.5 mm., anterior wing about 4 mm.; black, with thin grayish-white hair, abundant at sides of prothorax; head approximately circular seen from in front; clypeus shining, with very distinct punctures; front extremely densely punctured, but somewhat glistening; flagellum dull ferruginous beneath except basally; mesothorax and scutellum dullish, very closely punctured, the scutellum without any impressed line; sides of thorax dull; area of metathorax shining, with fine plicae not reaching apex; posterior truncation shining, sharply bounded about halfway up at sides; tegulae dark rufous, piceous at base; legs black, with grayish-white hair, tarsi reddish at apex; wings dusky, distinctly brownish, stigma and nervures dusky reddish; basal nervure close to nervulus; second cubital cell rather narrow; first recurrent nervure meeting second intercubitus; abdomen broad, highly polished; apices of segments laterally with very conspicuous white hair, and end of abdomen conspicuously hairy.

Preobrageniya Bay, Siberia, type locality, July 12, 4 females (Cockerell); Low Lighthouse, July 13, 1 female (Cockerell).

Paratype.—Cat. No. 27351, U.S.N.M.

HALICTUS PERPLEXANS, variety SPECULINUS, new variety

Female.—Differs by the polished and shining mesothorax and scutellum, the latter very brilliant, the punctures evidently separate; area of metathorax less strongly plicate; head distinctly narrower, longer than broad.

Preobrageniya Bay, Siberia, type locality, July 12, 1 female (Cockerell); Kudia River, July 2, females (Cockerell).

Paratype.—Cat. No. 27349, U.S.N.M.

Comparing the types of *perplexans* and *speculinus*, they certainly seem to be different species, although the rather striking abdomen is exactly the same in both. Some of the other specimens, however, are more or less intermediate, so I feel obliged to treat *speculinus* as a variety. The species is somewhat related to *H. opacus* Pérez, but quite distinct. It is still closer to *H. interruptus* Panzer, but readily separated by the area of metathorax.

HALICTUS BRACHYCEPHALUS, new species

Female.—Length about 5 mm., anterior wing a little over 4 mm.; black, with scanty grayish-white hair; head about as broad as long; clypeus short and little produced, shining, with scattered punctures; supraclypeal area large, convex, shining; sides of face glistening; front dull, but region about ocelli shining; flagellum ferruginous beneath; mesothorax and scutellum moderately shining, very finely punctured; scutellum with no impressed line; mesopleura dull, a little shining above; area of metathorax granular, dull, feebly plicate at base; posterior truncation shining; tegulae ferruginous; wings hyaline, slightly reddish; basal nervure rather close to nervulus; stigma and nervures dusky testaceous; second cubital cell rather broad, third also unusually broad for this group; recurrent nervure meeting second intercubitus; legs black, with red knees and small joints of tarsi; hind tibiae robust; abdomen broad, polished, hind margins of segments very narrowly rufous; narrow white hair bands on lateral apices of segments 3 and 4; apex of abdomen ferruginous.

Kongaus, Siberia, August, 3 females (Cockerell).

This may be compared with *H. gracilis* Morawitz, but is very distinct.

HALICTUS TRICHORHINUS, new species

Female.—Length about 6 mm., anterior wing 5.8 mm.; black, very robust, with rather copious pale hair, which is very faintly yellowish dorsally; face very broad, densely covered with grayish hair; clypeus shining; front very densely punctured but distinctly shining; antennae black, at most very obscurely reddish beneath

subapically; mesothorax and scutellum moderately shining (not polished), closely and distinctly punctured, the median line of mesothorax not evidently impressed, and no line on scutellum; upper part of mesopleura shining; area of metathorax with strong plicae, not reaching apex, the latter not sharply defined; posterior truncation with median sulcus very strong; tegulae rufous, dark at base; wings strongly dusky (dilute fuliginous), stigma and nervures dusky testaceous; basal nervure rather near to nervulus; second cubital cell conspicuously narrowed above, receiving recurrent nervure near its end; legs black, with white hair; abdomen very broad, shining (dull at base of second segment), hind margins of segments not reddened; very narrow white hair bands on lateral hind margins of segments 2 and 3; much pale hair at apex.

Low Lighthouse, Siberia, July 3, 3 females (Cockerell).

Type.—Cat. No. 27350, U.S.N.M.

The following notes will assist in the separation of the above species:

H. transpositus has the punctures of mesothorax much larger than in *H. tutihensis.*

H. suprafulgens is easily separated from *H. trichorhinus* by the shining mesothorax and lines between punctures on front.

H. brachycephalus is easily known from *H. perplexans*, variety *speculinus*, by the sides of mesothorax rough and sculptured between punctures.

H. perplexans is readily known from *H. sulcatulus* by the hind margins of segments 1 to 4 with dense fringe of white plumose hairs laterally. *H. sulcatulus* has the punctures of mesothorax weaker than in *perplexans.*

The impressed lines on scutellum readily separate *H. sulcatulus* from *H. perplexans*, *H. trichorhinus*, and *H. brachycephalus.*

H. transpositus and *H. tutihensis* are noteworthy for the remoteness of the basal nervure from the nervulus.

H. suprafulgens differs from all the others by the broad white bands at bases of segments 2 to 4.

BUPRESTID BEETLES FROM THE MARITIME PROVINCE OF SIBERIA

By W. S. Fisher

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The present paper is the result of a study of the Buprestid beetles received from Prof. T. D. A. Cockerell, and which were collected on his journey through the eastern part of Siberia during July and August, 1923. The material of this family collected by Professor Cockerell and his associates consists of 11 species, 2 of which are described as new.

All of the species collected belong to the typical Palaearctic fauna; some of them are distributed eastward over the greater part of Siberia and Europe, and in one case the species is circumpolar in its distribution extending over the northern parts of both the Eastern and Western Hemispheres.

LAMPRA VIRGATA (Motschulsky)

Paecilonota virgata Motschulsky, Bull. Soc. Imp. Nat. Moscou, vol. 32, pt. 2, 1859, p. 490.

This species was originally described from the Amur River region in Siberia. Motschulsky's description is very short, but Solsky in his Coleoptera of eastern Siberia[1] gives a long description of this species and records it as having been collected during June in the vicinity of Lake Khanka, which is situated near Vladivostok, Siberia.

This beautiful species is represented by three examples, two collected at Vladivostok by V. Prinada, and the third example taken during July 1923, by T. D. A. Cockerell along the Kudia River, in the Province of Amagu. The specimens examined vary considerably in the number and arrangement of the violaceous spots on the upper surface, and the color is more cupreous or aureous on some of the specimens.

The species resembles *Lampra festiva* Linnaeus from Europe very closely, and is probably only a variety of that species.

[1] Horae Soc. Entomol. Rossicae, vol. 7, 1871, pp. 353–356

BUPRESTIS STRIGOSA Gebler

Buprestis strigosa GEBLER, Ledebours Reise, vol. 2, pt. 2, 1830, pp. 78–79.

This species was described by Gebler from Siberia, and was reported by him as having been collected frequently in the Alta Mountains and Davuria, and rarely at Barnaul. Motschulsky[2] reports it as common with *Buprestis haemorrhoidalis* Herbst (*B. punctata* Fabricius) in the forests of fir near the northern part of the Amur River, and gives it the varietal name *flavosparsa* without giving a description of it. It seems to be a common species and widely distributed throughout Siberia and Mongolia.

Nine specimens, five males and four females, were examined, of which seven were collected by A. I. Lavrushin along the Amagu River during July, 1923, and the other two by T. D. A. Cockerell along the Kudia River, in the Province of Amagu, during July, 1923.

The color markings are quite variable in this species; some have the elytra immaculate, while in others the yellow markings are quite distinct. The yellow spot at apical angle of pronotum is also variable in size, and is entirely absent in one specimen.

The males have a large broad hook at the tip of the anterior tibiae, and the last abdominal segment is feebly arcuately emarginate at the apex, and usually only the last segment ornated with yellow spots at the sides, but in one specimen these spots are entirely absent.

In the females the anterior tibiae are not armed with a hook, and usually all of the abdominal segments are marked with yellow spots at the sides, and the last segment is broadly truncate at apex.

BUPRESTIS HAEMORRHOIDALIS Herbst

Buprestis haemorrhoidalis HERBST, Schriften Berl. Gesellsch. Nat. Freunde, vol. 1, 1779, p. 97.

Herbst described this species under the above name from Europe, and later it was described by a number of other writers under various names, all of which have been placed as synonyms of *haemorrhoidalis* by Kerremans.[3] Motschulsky,[4] under the name of *Buprestis punctata* Fabricius (placed as a synonym of *haemorrhoidalis* by Kerremans), records it as being very common in the forests of fir near the northern part of the Amur River in eastern Siberia. The color markings on this species are also variable, and if the synonym given by Kerremans is correct, the species has a wide distribution, living in the conifers throughout Europe and Siberia.

[2] Schrenk's Reisen und Forschungen im Amur-Lande, vol. 2, 1860, p. 108.
[3] Wytsman Genera Insectorum, fasc. 12, pt. 3, 1903, p. 141.
[4] Schrenk's Reisen und Forschungen im Amur-Lande, vol. 2, 1860, p. 107.

A single female of this species was collected by T. D. A. Cockerell at Okeanskaja, during August, 1923. This specimen is of a uniform dark brown color above, with a distinct cupreous, greenish, or purplish reflection when viewed in different lights, and the upper surface is immaculate, except for a very small yellow spot at the apical angles of the pronotum; beneath the color is more purplish, the last abdominal segment is broadly truncate and feebly sinuate at apex, and on each side ornated with a large yellow spot.

This species is larger and more elongate than *Buprestis strigosa* Gebler, more convex above, sides of pronotum more regularly obliquely expanded from the apical angles to the base, and the elytra not as strongly longitudinally costate.

DICERCA ACUMINATA (Pallas)

Buprestis acuminata PALLAS, Icones Insectorum, 1871, p. 69, no. 10, pl. D, fig. 10.

This is another Palaearctic species which is distributed throughout Europe and Siberia. Motschulsky[5] records it from along the banks of the Amur River as far as Kidsi.

Two examples of this species were collected by T. D. A. Cockerell at Okeanskaja during August, 1923.

MELANOPHILA ACUMINATA (De Geer)

Buprestis acuminata DE GEER, Mém. Ins., vol. 4, 1774, p. 133.

This circumpolar species is distributed over the greater part of Europe, Siberia, and North America and on account of its wide distribution has been described under a great many different names by various writers.

This species is represented in the material examined by four examples, three collected by T. D. A. Cockerell along the Kudia River, in the Province of Amagu, during July, 1923, and one taken along the Amagu River by A. I. Lavrushin during July of the same year.

ANTHAXIA PSITTACINA Heyden

Anthaxia psittacina HEYDEN, Deutsche Entomol. Zeitschr., vol. 31, 1887, p. 303.

This species was described from two examples collected at Suyfun, near the mouth of the Amur River in Siberia. It is represented among the material collected by T. D. A. Cockerell in Siberia during August, 1923, by five specimens, two of which were taken at Okeanskaja and the other three at Kongaus.

[5] Schrenk's Reisen und Forschungen im Amur-Lande, vol. 2, 1860, p. 107.

AGRILUS IMPRESSIFRONS Kiesenwetter

Agrilus impressifrons KIESENWETTER, Deutsche Entomol. Zeitschr., vol. 23, 1879, pp. 254–255.

This species was described from the Amur River region of Siberia, and among the material received from T. D. A. Cockerell is one specimen collected by V. Prinada at Vladivostok during 1923.

AGRILUS SMARAGDINUS Solsky

Agrilus smaragdinus SOLSKY, Horae Soc. Entomol. Rossicae, vol. 11, 1876, pp. 279–280.

This beautiful green species was described from a single example collected by Mr. Pouzilo along the banks of the Souyfoun River near Vladivostok.

Among the material submitted by T. D. A. Cockerell was a single example of this species collected at Vladivostok, during 1923, by V. Prinada.

AGRILUS COCKERELLI, new species

Female.—Form rather large, robust, and moderately shining; above glabrous, uniformly dark blue with a slight greenish tinge; beneath blackish-blue, slightly more shining than above, and with the tarsi feebly aeneous.

Head with the front rather wide, feebly convex, and the sides obliquely expanding toward the top, broadly but obsoletely concave on the front, with a rather broad, distinct longitudinal groove on the vertex and occiput; surface coarsely, irregularly, and rather densely punctate, and with moderately fine irregularly placed rugae, which are transverse on the front, and more or less concentrical on the occiput; epistoma slightly wider between the antennae than the diameter of the antennal cavities, transverse in front, with a small angular emargination at the middle; antennae moderately long, and serrate from the fourth joint.

Pronotum nearly one and one-third times as wide as long, slightly narrower at base than apex, and widest at apical fourth; sides feebly expanded from apical angles to apical fourth, then obliquely narrowed to the posterior angles, which are nearly rectangular; when viewed from the side the upper margin is sharply defined and feebly sinuate, and the lower margin distinct, widely separated anteriorly, and connected to the upper margin behind the middle; anterior margin obsoletely arcuately rounded; base rather strongly angularly emarginate at elytral lobes, and feebly arcuately emarginate in front of scutellum; surface moderately convex, with two shallow depressions on disk at apical third, a similar depression on each side along base near poste-

rior angle, and a broader and much deeper depression along the lateral margins near middle, the lateral carina not distinct, and represented by an obsolete arcuate elevation, coarsely, densely, and irregularly rugose, and finely and rather densely punctate between the rugae. Scutellum transversely carinate, the carina broadly rounded on top: sides parallel anteriorly, and strongly arcuately attenuate posteriorly to the apex, which is acute; surface finely and densely granulose.

Elytra slightly wider than pronotum at base, and four times as long as it; sides parallel for a short distance behind the base, broadly arcuately constricted in front of middle, broadly arcuately rounded behind the middle, then arcuately attenuate to the tips, which are separately narrowly rounded and obsoletely dentate; disk moderately convex, and each elytron with a broad basal depression, which is deep at the basal margin, but becoming more shallow posteriorly and extending behind the tip of the scutellum, and with a broad obsolete longitudinal depression behind the middle along the suture, which is rather strongly elevated posteriorly; surface coarsely and densely imbricate-punctate.

Abdomen with the sides broadly exposed above, and beneath sparsely but not deeply punctate, the punctures very coarse and more or less confluent at base of first segment, but becoming finer and more widely separated toward apex, sparsely clothed with short inconspicuous hairs, and the intervals finely, densely granulose; first segment convex at middle, and without any median depression; last segment narrowly rounded at apex, with a small angular emargination at the middle; pygidium with a distinct median carina, which does not extend to apex. Prosternum coarsely scabrous, with the intervals finely granulose and glabrous; prosternal lobe large, broadly rounded in front, deeply and broadly arcuately emarginate at the middle, and strongly declivous; prosternal process longitudinally concave, the sides parallel to behind the coxal cavities, then strongly attenuate to the tip, which is rather acute. Femora flattened and not armed with teeth on the inner margin. Tibiae slender, straight and not mucronate at apex. Posterior tarsi much shorter than the tibiae, and the first joint about as long as the following two joints united. Tarsal claws cleft at middle, the inner tooth about one-half as long as the outer tooth, and not turned inward (claws on middle tarsi missing).

Length, 7 mm.; width, 2.5 mm.

Type locality.—Vladivostok, Siberia.

Type.—Cat. No. 27562, U.S.N.M.

Described from a single female collected at the type locality during 1923 by V. Prinada.

This species is closely allied to *elongatus* Herbst, but that species is more elongate and slender, the head is narrower in front, with the sides arcuately expanded at vertex, and not depresssed on the front, prothorax with the sides more strongly narrowed, and the disk more deeply depressed, pygidium not longitudinally carinate, prosternal lobe not as deeply emarginate in front, and not as strongly declivous, and the posterior tarsi nearly as long as the tibiae.

AGRILUS PRINADAI, new species

Female.—Form moderately large, more slender than *cockerelli* Fisher, and subopaque; above dark aeneous, with a more or less brownish and bluish tinge, the head slightly more aureous in front, and the pronotum obsoletely cupreous on disk; beneath aeneous, with a distinct bluish and blackish-brown reflection, and more shining than above.

Head rather narrow and nearly flat in front, with the sides nearly parallel (only feebly arcuately expanded at vertex), feebly longitudinally grooved from vertex to near the epistoma, the groove more deeply impressed on the vertex, and terminating in a broad shallow depression on the front; surface coarsely, irregularly punctate, and coarsely rugose, the rugae irregular, and more or less transverse on the front, but becoming longitudinal on the occiput, and sparsely clothed with short semierect whitish hairs; epistoma about as wide between the antennae as the diameter of the antennal cavities, and broadly, but not deeply, arcuately emarginate in front; antennae extending to about middle of pronotum, and serrate from the fourth joint.

Pronotum about one and three-fourths times as wide as long, slightly narrower at base than apex, and widest near apical angles; sides feebly obliquely narrowed from anterior margin to posterior angles, which are rectangular; when viewed from the side the upper margin is sharply defined and strongly sinuate, and the lower margin distinct, arcuately expanded from the apical angles to the basal third where it is connected to the upper margin; anterior margin arcuately emarginate, and with a broadly rounded medina lobe; base deeply angularly emarginate at the elytral lobes, and nearly transversely truncate in front of scutellum; surface moderately convex, with a broad obsolete longitudinal depression on middle of disk, and with a broad, deep depression on each side along lateral margins, the lateral carina distinct, strongly elevated, straight, and extending from base near posterior angles to basal third, and widely separated from lateral margin, coarsely and densely rugose, the rugae more or less transverse on the disk, coarsely, densely punctate between the rugae, and sparsely clothed with short inconspicuous

pubescence toward the sides. Scutellum strongly transversely carinate, the carina acute on the top; sides parallel anteriorly, and strongly arcuately attenuate posteriorly to the apex, which is acute; surface finely, densely granulose.

Elytra about as wide as anterior part of pronotum at base, and five times as long as it; sides parallel for a short distance behind base, broadly arcuately constricted in front of middle, broadly arcuately rounded behind middle, then obliquely attenuate to the tips, which are separately feebly broadly rounded or subtruncate, and finely, irregularly dentate; disk slightly flattened, and each elytron with a broad, deep basal depression, and with a broad, obsolete longitudinal depression along the suture, which is scarcely elevated posteriorly; surface coarsely and densely imbricate punctate.

Abdomen with the sides broadly exposed above, and beneath finely, sparsely punctate, and more or less transversely striolate, sparsely clothed with short recumbent cinereous hairs, and with the intervals smooth; first segment convex at middle, and with a broad shallow depression on each side; last segment rather narrowly rounded at apex, with a shallow arcuate emargination at the middle; pygidium not longitudinally carinate. Prosternum coarsely, densely scabrous, sparsely clothed with short semierect cinereous pubescence, and the intervals obsoletely granulose; prosternal lobe large, broadly rounded in front, broadly arcuately emarginate at middle, and strongly declivous; prosternal process flat, the sides parallel to behind the coxal cavities, then strongly attenuate to the tip, which is rather acute. Femora slightly flattened and not armed with teeth on the inner margin. Tibiae slender, straight, and not mucronate at apex. Posterior tarsi much shorter than the tibiae, and the first joint about as long as the following three joints united. Tarsal claws cleft at middle, the inner tooth broad, about one-half as long as the outer tooth, and not turned inward (claws on middle and posterior tarsi missing).

Male.—Differs from the female in being smaller, more slender, head without a depression on the front, and the epistoma not as distinctly and broadly emarginate in front, elytra more convex and scarcely depressed along the suture, and the last abdominal segment more deeply emarginate at apex.

Length, 4.75–6 mm.; width, 1.5–2 mm.

Type locality.—Vladivostok, Siberia.

Type and allotype.—Cat. No. 27563, U.S.N.M.

Described from two specimens, male and female, both collected at the type locality during 1923 by V. Prinada.

TRACHYS MINUTA (Linnaeus)

Buprestis minuta LINNAEUS, Systema Naturae, ed. 10, vol. 1, 1758, p. 410.

This species is also widely distributed throughout Europe and Siberia, but is rather rare in some sections. Solsky[6] has recorded it as having been collected by Mr. Pouzilo in the vicinity of Vladivostok, Siberia.

One example, which is identical with specimens of this species from Europe, was collected by T. D. A. Cockerell at Olga, during July, 1923.

[6] Horae Soc. Entomol. Rossicae, vol. 11, 1876, p. 281.

SAWFLIES FROM THE MARITIME PROVINCE OF SIBERIA

By S. A. Rohwer

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The following paper is a report on the sawflies collected in the Maritime Province of Siberia by Prof. T. D. A. Cockerell and his associates in the summer of 1923. The collection contained 31 species, 28 of which are named specifically. Eleven species and one variety are described as new.

Most of the new species show a very close affinity to European forms, and of the previously described species nine were originally described from Europe. Three of the European species are here recorded from Siberia for the first time. One of the species had previously been known only from Japan; three of them were known only from China, and one was known only from Formosa. Judging from the sawflies alone we may say that the fauna of this maritime province is essentially Palaearctic but with a slight southern infusion.

MEGALODONTES (RHIPIDIOCEROS) SIBERIENSIS, new species

This species seems to be most closely related to *flabellicornis* where it runs in Konow's key, but the head and thorax have fewer pale marks, the femora are dark, etc.

Female.—Length, 10 mm. First joint of the flagellum subequal with the three following and nearly as long as the two apical joints; the flabellation of the third joint as long as the three following joints; the flabellations of joints 3, 4, 5, 6, 7, and 8 are subequal; pedicellum about half the length of the third joint; clypeus convex medianly, the anterior margin truncate; antennal foveae sharply defined, large, pointed above; postocellar area completely defined, broader posteriorly, its length subequal with its greatest width; postocellar line less than half as long as the ocellocular line; head coarsely, closely punctuate except on the posterior orbits, where the punctures are distinct and separated by a distance fully twice their diameter; prescutum with large, close punctures posteriorly, anteriorly the punctures well separated; scutum and scutellum irregularly punctuate, the punctures sometimes confluent; nervulus slightly post-

furcal; first abscissa of radius slightly shorter than second. Black; an indistinct spot on the clypeus medianly, the supraclypeal area, a narrow line along the posterior orbits extending obliquely across the vertex to the occiput, the narrow, posterior margin of the pronotum, the apical margins of tergites 4 to 9, inclusive (slightly interrupted medianly on sixth), and two obscure spots on the sides of the third tergite, bright-yellow; tibiae and tarsi rufo-ferrugineous; wings brownish hyaline, the anterior portion of the front wings darker; venation dark-brown; costa and stigma pale-brown; head and thorax clothed with long, black hair.

The paratype females have an oblique spot on the posterior dorsal part of the scutum and in one of them the lateral spot on the third tergite is wanting.

Male.—Length, 10 mm. The male differs from the above description of the female in color as follows: Mandibles, except apices, the entire clypeus, scape beneath, a large spot on the side of the pronotum, proepisternum, anterior margin of mesepisternum, tegulae, all of the sternites and an obscure spot on the side of the second tergite, yellow. The apices of the four anterior femora and most of the posterior femora are testaceous.

Type-locality.—Okeanskaja, Siberia.

Paratype-locality.—Kongaus, Siberia.

Described from one female from the type locality collected August 15, 1923, by T. D. A. Cockerell, from two females and one male (allotype) from the paratype locality collected August, 1923, by T. D. A. Cockerell.

Type, allotype, and paratypes.—Cat. No. 27613, U.S.N.M.

The two paratype females and the allotype male lack the antennae beyond the scape.

TRICHIOSOMA SERICEA Konow

One female from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell.

ARGE, species

A single male from Kudia River, Amagu, Siberia, collected in July, 1923, by T. D. A. Cockerell does not seem to be described. It is related to *cyaneocrocera* and may be the male of *kongauensis* but at present can not be definitely associated.

ARGE CINGULATA Jakowlew

One female, which lacks the flagellum, from Kongaus, Siberia, collected August, 1923, by T. D. A. Cockerell. This specimen agrees well with both Jakowlew's and Konow's descriptions of this species.

ARGE METALLICA (Klug)

Two females from Kongaus, Siberia, collected August, 1923. One collected by T. D. A. Cockerell, the other by A. I. Lavrushin. These agree very well with Konow's redescription of the species. The specimen collected by Cockerell has the flagellum ferrugineous while the specimen collected by Lavrushin has the flagellum black.

ARGE KONGAUENSIS, new species

Related to *melanochroa* (Gemlin) and *cyaneocrocera* (Forster) but is more robust and the head is distinctly expanded behind the eyes.

Female.—Length, 8.5 mm. Anterior margin of the clypeus with a broad, quadrate emargination, the lobes narrowed and broadly rounded; supraclypeal area carinated; antennal foveae very deep and continuous with the supraclypeal foveae; frontal fovea very sharply defined, acutely angled ventrally with a well-defined pit opposite the level of the antennae and with an indistinct transverse ridge ventrad of the pit, the fovea not extending dorsally to the level of the anterior ocellus; postocellar furrow obsolete; basal vein and cubitus interstitial on the subcosta; stigma angulate basally, tapering to an acute apex; third intercubitus gently curved so the third cubital cell is slightly longer on radius; the nervulus in the middle of the cell. Metallic green; palpi ferrugineous; tergites 2 to 4 and most of the sternites obscurely ferrugineous; legs black; anterior femur beneath and all of the tibiae and tarsi luteous; wings yellowish, hyaline, with a distinct infuscate cloud below the stigma; venation dark brown; costa and anterior half of subcosta yellow; head and thorax clothed with sparse gray hair.

Type-locality.—Kongaus, Siberia.

Described from a single female collected August, 1923, by T. D. A. Cockerell.

Type.—Cat. No. 27614, U.S.N.M.

ARGE NYEMITAWA, new species

This species runs to *berberidis* (Klug) in Konow's key but the flagellum is more robust and the head is expanded behind the eyes. Besides the noncompressed flagellum this new species may be separated from certain species from eastern Asia as follows: From *verticosa* Konow by the position of the nervulus; from *accliviceps* Konow by head characters; from *carinicornis* Konow, *similis* Vollenhoven and *compar* Konow, by the short flagellum.

Female.—Length, 10 mm. The anterior margin of the clypeus very sligthly arcuately emarginate; supraclypeal area broadly convexed without a median carina; antennal and supraclypeal foveae

separated; frontal fovea broad, shallow, poorly defined ventrally well defined dorsally and extending above the anterior ocellus; immediately below the anterior ocellus is a broad, shallow, depressed area; postocellar furrow present; postocellar area fully twice as broad as long; head distinctly expanded behind the eyes; flagellum not compressed, shorter than the thorax and distinctly thickening apically; basal vein and cubitus joining the subcosta at the same place; third intercubitus strongly curved so the third cubital cell is one-fifth shorter on the cubitus; nervulus distinctly beyond the middle. Bright, metallic blue; tarsi and flagellum black; wings dark brown with a strong violaceous reflection posteriorly, becoming paler apically; venation, including costa and stigma, black; head and thorax clothed with short, black hair.

Type-locality.—Okeanskaja, Siberia.

Described from a single female collected by T. D. A. Cockerell in August, 1923.

Type.—Cat. No. 27615, U.S.N.M.

ARGE PAGANIFORMIS, new species

Closely allied to *pagana* (Panzer) and *geei* Rohwer. Can readily be distinguished from both of these species by the truncate, anterior margin of the clypeus.

Female.—Length, 6.5 mm. Anterior margin of the clypeus truncate, supraclypeal area strongly convex but not carinate; frontal fovea broader and deeper between the bases of the antennae, very slightly expanded just below the anterior ocellus; postocellar area very indistinctly defined; head distinctly expanded behind the eyes; flagellum cylindrical, subequal in length with the thorax; basal vein joining the subcosta slightly before the origin of the cubitus; third intercubitus strongly curved; third abscissa of radius one-fifth longer than the posterior margin of the third cubital cell; nervulus received at the middle of cell. Metallic blue; abdomen beyond the first segment ferrugineous; legs metallic except the black tibiae and tarsi; wings dark brown with a slight violaceous reflection; venation, including costa and stigma, black.

Type-locality.—Okeanskaja, Siberia.

Described from a single female collected August 5, 1923, by T. D. A. Cockerell.

Type.—Cat. No. 27616, U.S.N.M.

ALLANTUS (EMPHYTUS) BASALIS (Klug)

Tenthredo (Emphytus) basalis Klug, Magaz. Ges. Naturf. Fr. Berlin, vol. 8, 1814, p. 282.

Allantus cinctus nigritibialis Rohwer, Proc. U. S. Nat. Mus., vol. 41, no. 1866, 1911, p. 407.

A single female from Kongaus, Siberia, collected in August, 1923, by T. D. A. Cockerell. This agrees well with Enslin's redescription and there seems to be no reason to doubt the above synonymy.

AMETASTEGIA GLABRATA (Fallén)

Two females from Vladivostok collected July 31, 1923, by T. D. A. Cockerell; and one female from Okeanskaja, Siberia, collected August, 1923, by T. D. A. Cockerell.

DOLERUS OKEANSKAJENSIS, new species

In general appearance and color very closely resembles the Nearctic species *similis* Norton and allies but differs from all of these in details of the sculpture of the head and thorax and in the shape of the sheath. From *variegatus* Jakowlew it may be separated by the pale lobes of the scutum, from *armillatus* Konow the pale tegulae and broader rufous band on the abdomen will distinguish it.

Female.—Length, 9 mm. Clypeus with a rather narrow, deep, subarcuate emargination, the lobes broad, truncate, the surface covered with coarse, contiguous punctures; frons coarsely punctured; antennal furrows shallow; posterior orbits and sides of vertex shining but with separate distinct punctures; postocellar furrow faintly indicated; postocellar area with elongate, contiguous punctures; prescutum with well-defined, rather large, close punctures (punctures rather closer medianly); scutum laterally punctured like the prescutum but medianly with the punctures closer and smaller; scutellum with close, large, uniform punctures; postnotum (scutellar appendage) longitudinally aciculate on an opaque surface, without a distinct median ridge; mesepisternum punctato-reticulate, mesosternum shining with scattered, rather small, but well-defined punctures; sheath broad, acute apically, tapering below; antenna shorter than the head and thorax; the median joints of the flagellum compressed, the first joint distinctly longer than the second which is subequal with the third; tergites polished. Black; pronotum, prescutum, scutum (except immediately in front of the scutellum), tegulae, abdominal segments two to five, inclusive, rufous; legs, black; the under side of the anterior femora, the anterior tibiae, the intermediate tibiae obscurely beneath, rufous. Body, densely clothed with long gray hair. Wings hyaline; venation black.

Male.—Length 9 mm. Head sculptured like the female except the vertex is more closely punctured posteriorly the sides of the prescutum have the punctures more widely separated. Black; anterior femora beneath at the apex, the entire anterior tibiae, rufous. More densely clothed with white hair than the female.

The paratype male has the base of the intermediate tibiae obscurely rufous, and the posterior tarsi are brownish.

Type-locality.—Okeanskaja, Siberia.

Described from one female (type) and two males (one allotype), collected August, 1923, by T. D. A. Cockerell. The type and allotype were collected August 5th.

Type, allotype, and paratype.—Cat. No. 27617, U.S.N.M.

RHOGOGASTER KUDIANUS, new species

This species seems to be intermediate between *R. viridis* (Linnaeus) and *R. dissimulans* (Kincaid). In general color it is much like Kincaid's species, but it differs from it in the more deeply emarginate clypeus and the dark markings at the apices of the tarsi. It may readily be separated from *viridis* by the complete absence of black on the abdomen, a slight difference in the shape of the sheath and shorter antennae.

Female.—Length, 9.5 mm. Labrum broad, the apical margin almost truncate, anterior margin of the clypeus with a deep, subquadrate emargination, the lobes broad and truncate; head without punctures; postocellar furrow straight; postocellar area more than two times as broad as long; occipital carina sharply defined; antenna slender, a little longer than the head and thorax, the third joint subequal with the fourth and fifth; thorax smooth; second intercubitus sinuate; fourth abscissa of cubitus one-third as long as the third; sheath stout, strongly convex below, the apex narrowly rounded. Uniformly pale-yellow (green in life); flagellum, except the two basal joints beneath, scape and pedicellum above, a U-shaped mark on the frons, the small spot inclosing the anterior ocellus, suture of prescutum, sides and depressed area of scutum, black; legs color of the body; apices of the four anterior femora above, the posterior femora with a complete narrow line above, narrow lines on all tibiae above, apices of all tarsi, black; wings clear hyaline, strongly iridescent; venation yellow; costa, basal, median, discoidal and anal veins, black.

Type-locality.—Kudia River, Amagu, Siberia.

Described from a single female collected July, 1923, by T. D. A. Cockerell.

Type.—Cat. No. 27618, U.S.N.M.

SIOBLA RUFICORNIS (Cameron)

One female from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell.

This specimen agrees with Cameron's and Kirby's descriptions, except the hind femora are entirely black.

PACHYPROTASIS ANTENNATA (Klug)

A single female from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell.

In this specimen the upper part of the mesepisternum is narrowly black; the prescutum is margined with yellow only posteriorly; the hind tibiae are black except for a small spot exteriorly.

MACROPHYA APICALIS, variety INFUMATA, new variety

Female.—Length, 9 mm. Differs from the typical form which occurs in Japan by having the hind trochanters black and in having the wings distinctly infumated. Apex of stigma and the costa piceous.

Paratype females are 11 and 12 mm. in length.

Male.—Length, 9 mm. Differs from the female in having the scutellum and hind coxae all black (without white markings).

Type-locality.—Kudia River, Amagu, Siberia.

Paratype-locality.—Kongaus, Siberia.

Described from one female (type) and one male (allotype) from the type-locality collected by T. D. A. Cockerell July, 1923; and from two females from the paratype-locality collected by T. D. A. Cockerell August, 1923.

Type, allotype, and paratypes.—Cat. No. 28478, U.S.N.M.

TENTHREDO FUSCOCOSTALIS, new species

This species is closely allied to *Tenthredo vespa* (Retzius) but may be separated from it by the much blacker legs, the presence of small yellow spots on the scutellum, and the greatly reduced yellow markings on the abdomen. The tegulae in the new species are almost entirely black.

Female.—Length, 11 mm. Labrum smooth, broadly rounded apically; clypeus smooth with a deep, broad, arcuate emargination, the lobes narrowly rounded apically; frons with distinct, coarse punctures which medianly tend to become confluent so as to give a slightly wrinkled appearance; posterior orbits with very small punctures; head not narrowing behind the eyes; postocellar area sharply defined laterally, feebly defined anteriorly, about twice as broad as long; occiput distinctly margined; antenna distinctly thickened apically, the seventh and eighth joints one-fourth broader than long; mesonotum with coarse, distinct punctures which are somewhat closer medianly; scutellum transversely convex, not as coarsely punctured as the scutum; mesepisternum coarsely punctato-reticulate; first tergite smooth, the following tergites with small, distinct punctures on a granular surface, the punctures larger on the anterior tergites; stigma truncate apically; fifth abscissa of the

cubitus one-third shorter than the fourth abscissa; sheath straight above, rounded apically, convex below. Black; clypeus (except margin), scape, metaepisternum, narrow margin of the first, fourth, and fifth tergites, a median spot on the seventh, eighth, and ninth tergites, two spots on scutellum, small anterior spot on tegulae, yellow; legs black, apices of the anterior femora beneath, the four anterior tibiae beneath, and posterior tibiae (except apices), yellow; wings subhyaline, radial, anterior margin of cubital and apical part of first discoidal cells, brownish; venation black, costa and stigma, reddish yellow; thorax with short, gray hair.

Type-locality.—Kongaus, Siberia.

Described from a single female collected August, 1923, by T. D. A. Cockerell.

Type.—Cat. No. 27619, U.S.N.M.

TENTHREDO KONGAUANA, new species

This species seems to be allied to *Tenthredo ornatus* (E. André) but differs from the description of that species in the absence of many black markings. From Enslin's redescription of *Tenthredella microps* (Konow) it differs in the absence of black spots from the clypeus, the absence of a black line on the anterior legs, and the more strongly convex scutellum.

Female.—Length, 11 mm. Anterior margin of the labrum broadly rounded anteriorly; the clypeus with a broad, deep, arcuate emargination and narrow, obtuse lobes; head shining, practically without sculpture; antennal furrows complete; no flange above the bases of the antennae; postocellar furrow straight, well defined; postocellar area narrowing anteriorly; third antennal joint nearly as long as the two following; the flagellum short, of uniform width; occipital carina feeble; mesoscutum and prescutum with small, well-separated punctures; scutellum smooth, strongly convex but hardly pyramidal; mesepisternum very finely tessellated, the median tubercle prominent; fourth abscissa of cubitus subequal with the second intercubitus; interradius strongly curved apically; third intercubitus about five times as long as the second; sheath broadly rounded apically, convex above and below. Pale-yellow (perhaps green in life); pedicle, flagellum, a large spot on frons including the ocelli and W-shaped dorsally, spots on lateral lobes, a large spot on the prescutum, black; the second, third, and fourth tergites brownish medianly; legs the color of the body; the apices of the hind femora dorsally, the dorsal part of the posterior tibiae and all of the posterior tarsi, black; wings hyaline; venation dark brown; costa and stigma pale yellow. Body without long hair.

Type-locality.—Kongaus, Siberia.

Described from two females (one type) collected in August, 1923. The type collected by T. D. A. Cockerell, the paratype by A. I. Lavrushin.

Type and paratype.—Cat. No. 27620, U.S.N.M.

TENTHREDO KUDIANA, new species

This species differs from *Tenthredo andreas* (Jakowlew) by the yellow margins of the pronotum and tegulae, from *T. sublimus* (Konow) by the dark stigma, from *T. kohli* (Konow) by the different markings of the head and black prescutum. Superficially, the species seems to be allied to *T. bernardi* (Konow), but it differs from Konow's description in having the face and frons black.

Female.—Length, 9 mm. Anterior margin of the clypeus broadly, subquadrately emarginate; head with distinct, although fine, irregular, striato-punctations; the orbits not receding, shining; occiput feebly margined, third antennal joint nearly one-half longer than the fourth; scutum and prescutum opaque with close, well-defined punctures, scutellum gently convex not pyramidal, interradius strongly curved, received a little before the apical third; fourth abscissa of cubitus a little less than one-half shorter than the third; tergites finely, transversely aciculate; sheath straight above, rounded apically and gently convex below. Black; base of mandibles, labrum, clypeus, obscure spot on supraclypeal area, malar space, lower half of posterior orbits, most of the pronotum, tegulae, oblique spots on scutum posteriorly, most of the scutellum, scutellar appendage, sides and venter of thorax (except an oblique line on mesepisternum), sternites, tergites laterally, narrow apical margin of first and fourth tergites, tenth tergite and most of the sheath, pale yellow (perhaps with a greenish tinge in life); legs pale yellow, anterior legs, intermediate femora and tibiae, posterior femora above, intermediate tarsi and posterior tibia and tarsi, black; head and thorax with short white hair; wings hyaline, venation (including costa and stigma) black.

Type-locality.—Kudia River, Amagu, Siberia.

Described from one female collected by T. D. A. Cockerell, July, 1923.

Type.—Cat. No. 27621, U.S.N.M.

TENTHREDELLA, species

A single female from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell lacks antennae. This species looks much like some of the Nearctic species but differs in details of color. It does not seem to be any of the species listed in Enslin's revision of the Palaearctic forms.

TENTHREDELLA FAGI (Panzer)

A female from Kudia River, Siberia, collected July, 1923, by T. D. A. Cockerell, runs to this species in Enslin's key and agrees with specimens determined by Enslin.

TENTHREDELLA FULVA (Klug)

One female from Kudia River, Amagu, Siberia, collected August, 1923, by T. D. A. Cockerell, agrees well with Enslin's redescription of this species.

TENTHREDELLA FUSCOTERMINATA (Marlatt)

Two females from Kongaus, Siberia, collected August, 1923, by T. D. A. Cockerell, agree with the types.

Enslin considers this to be a synonym of *xanthotarsis* (Cameron), but judging from the original description by Cameron and the redescription by Kirby the two forms may be separated by the following characters:

Head below the antennae punctured: pectus with a black spot; hind femora with a black line ..... xanthotarsis (Cameron).
Head below the antennae not punctured; pectus and hind femora without black ..... fuscoterminata (Marlatt).

TENTHREDELLA LIVIDA, variety DUBIA (Ström)

A female from Olga, Siberia, collected July 13, 1923, by T. D. A. Cockerell agrees with European specimens determined by Enslin.

TENTHREDELLA MESOMELAS (Linnaeus)

A single female from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell agrees with a European specimen determined by R. Meyer, but the venter is darker than in other European specimens. The venter is distinctly brownish. A single male from same locality has the marking on the tergites narrower and front legs without black.

TENTHREDELLA COCKERELLI, new species

This species is allied to *goliath* (Enslin) but differs from the description of that species in the absence of pale marks at the bases of the antennae, in the infuscate apices of the wings, and black sternites.

Female.—Length, 14 mm. Head broad, the posterior orbits distinctly wider than the cephal-caudad diameter of the eye; anterior margin of the labrum subacute; the clypeus with a rather shallow, arcuate emargination; supraclypeal area convex; frontal furrows deep; postocellar area completely defined by deep furrows, posterior

width a little greater than its length; head shining without distinct punctures; occiput strongly margined; third antennal joint about one-fourth longer than the fourth; scutum and prescutum shining but with small, distinct punctures; scutellum strongly, transversely convex; interradius strongly curved, received by the third cubital cell at apical third; third and fourth abscissa of the cubitus subequal; sheath rounded apically, convex below. Black; base of mandibles, labrum, two spots on the clypeus, an L-shaped mark from superior orbit to occiput (broader at occiput), the dorsal angles of pronotum, tegulae, spot on the scutellum, spot on metepisternum, sides of the basal plates, white; legs black, posterior trochanters, all tibiae and tarsi, except apices, white; wings hyaline, distinctly infumated around apex of the stigma; venation black; costa and stigma reddish-yellow.

Type-locality.—Kongaus, Siberia.

Described from a single female collected by T. D. A. Cockerell, August, 1923.

Type.—Cat. No. 27622, U.S.N.M.

SELANDRIA TEMPORALIS Thomson

One female from Kudia River, Amagu, Siberia, collected July, 1923, by W. P. Cockerell.

STROMBOCEROS DELICATULUS (Fallén)

One male from Kudia River, Amagu, Siberia, collected July, 1923, by T. D. A. Cockerell.

BUSARBIDEA FORMOSANA Rohwer

A single male from Okeanskaja, Siberia, collected August, 1923, by T. D. A. Cockerell.

This male agrees very closely with a paratype female and appears to be the undescribed male of this species.

PONTANIA, species

Two males from Okeanskaja, Siberia, collected August, 1923, by T. D. A. Cockerell.

PTERONIDEA NIGRICORNIS, variety SIBIRICA Jakowlew

One female from Okeanskaja, Siberia, collected August, 1923, by T. D. A. Cockerell.

PRISTOPHORA CHROMATA, new species

This species is very unusual in color for a species of the genus *Pristophora*. Judging from Enslin's key to the European species it is allied to *pallidula* Konow, but it differs from the description

of that species in the absence of black marks on the head and thorax and in the pale stigma.

Female.—Length, 6 mm. Apical margin of the labrum broadly rounded; clypeus with the lateral angles broadly rounded; supraclypeal area gently convexed, triangular in outline; supraclypeal foveae confluent with the antennal foveae; frontal foveae elongate; frontal crest prominent, unbroken; postocellar line a trifle shorter than the ocellocular line; postocellar furrow wanting; postocellar area with a distinct longitudinal, median furrow; vertical furrows complete, well defined; head slightly narrowing behind the eyes; antenna nearly as long as the body, the third joint a trifle shorter than the fourth; thorax shining, basal plates finely reticulate; tergites smooth; stigma angulate basally, gradually tapering to an acute apex; second recurrent antefurcal by a distance nearly equal to the length of the second intercubitus; recurrentella antefurcal by half the length of intercubitella; sheath broad, straight above, narrowly rounded at apex, rounding to a broad base; claws with a prominent inner tooth. Uniformly pale-yellow (perhaps green in life); head, spot on prescutum, elongate spots on scutum, with a distinct ferrugineous tinge; antennae with a narrow black line above; wings hyaline, strongly iridescent; venation dark-brown; costa, subcosta and stigma sordid-white.

Type-locality.—Kudia River, Amagu, Siberia.

Described from a single female collected July, 1923, by T. D. A. Cockerell.

Type.—Cat. No. 27623, U.S.N.M.

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NORTH AMERICAN SPECIES OF TWO-WINGED FLIES BELONGING TO THE TRIBE MILTOGRAMMINI

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INTRODUCTION

An attempt has been made in this paper to define the limits of a small group of Muscoid flies which have long been associated, somewhat incorrectly, by most American workers in Diptera with the family Tachinidae, and to render the species of the group thus defined readily determinable.

In the American literature of the past 30 years, with the exception of Townsend's, the genera which are discussed in this paper have been rather widely scattered among genera of Tachinidae with which they are but distantly related. Owing to the difficulty of obtaining a clear conception from the existing literature, of the limits of the group, and of the genera contained, it has been found advisable to define and redescribe quite fully. A special effort has been made in the generic descriptions to disregard characters which fall within the range of specific variation, and to make the limits of the genera, which fortunately are more readily distinguished than in the great central mass of either the Sarcophagidae or Tachinidae, broad enough to include not only the known species, but others as yet unknown, of which there must still be many. In the genera to which new species have been added, the old species not adequately defined have been quite fully redescribed.

It has been found necessary to change the generally accepted nomenclature and the synonomy to a considerable extent, from two causes; first the failure of earlier workers, doubtless handicapped by the lack of properly determined European material, to recognize the identity of certain American forms with previously described European species, and secondly, the inclusion in one genus, namely *Hilarella*, of several heterogenous Nearctic elements each of which is very evidently entitled to generic rank. While Coquillett's conception of the genera of this group has been adhered to in most cases, the author has recognized some of Townsend's genera not hitherto generally accepted.

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The types of very nearly all the species described by Coquillett and Townsend, most of which are deposited in the United States National Museum, have been examined. Prof. S. J. Hunter of the University of Kansas very kindly loaned Townsend's types deposited there, for examination. A study of these revealed that three of the types, long submerged in synonomy, undoubtedly represent distinct species, but in most the synonomy of Coquillett and of Aldrich was confirmed. Van der Wulp's types of Mexican and Central American species which are located in the British Museum, were not seen, but correspondence with the museum cleared up some of the uncertainty surrounding these species. It is to be regreted that the position of *Miltogramma erythrura* and *M. nana* of Van der Wulp could not be unquestionably settled at this time. The types of species described by Meigen, Rossi, Fallen, and Zetterstedt were not seen, and their present location is not known to me, but most represent well known European species, of which I have seen determined specimens from several European workers, and about the identity of which there can be little doubt. Macquart's types of the North American *Metopia lateralis* and *Senotainia rubriventris* were not seen and their present location is not known. However, very fortunately, both may be quite certainly distinguished from the other known species by the original description.

In the course of the work on this group, considerable scattered information has been secured on the morphology of the immature stages, which has been submitted for the purpose of clearing away some of the uncertainty regarding the taxonomic position of the Miltogramminae. Notes on the biology of certain species have also been included.

To Dr. J. M. Aldrich, I am most deeply indebted for so freely placing the facilities of the United States National Museum at my disposal, and for frequent consultations and much correspondence, at the cost of much inconvenience and loss of time to himself. To Prof. S. J. Hunter, I am also very deeply indebted for the loan of type material from the University of Kansas Museum, the examination of which has contributed materially to the accuracy of this paper. I am indebted to C. W. Johnson for the opportunity to examine his fine collection, and that of the Boston Natural History Society, as well as for much helpful correspondence on the group; to Prof. M. Bezzi of Italy, who loaned for study specimens of several European genera of Miltogramminae not known in the North American fauna; to Doctor Zerny, who loaned for study North American material deposited in the Imperial Museum at Vienna, which included the type of *Arrenopus americanus;* to Maj. E. E. Austen and his assistants in the British Museum for helpful correspondence concerning Van der Wulp's types; to Prof. R. W·

Harned, of Agricultural and Mechanical College of Mississippi, for providing an opportunity to study collections in the Eastern States, to J. R. Ricks, director of the Mississippi Agricultural Experiment Station, for allowing time for the completion of the manuscript; and to Prof. E. W. Stafford for much helpful criticism. Thanks are due, also, to Nathan Banks, J. R. Malloch, Prof. J. S. Hine, C. Howard Curran, H. J. Reinhard, C. S. Brimley, A. F. Burgess, Dr. H. T. Fernald and R. C. Shannon for allowing me to examine their collections or the collections in their charge.

CLASSIFICATION

Family SARCOPHAGIDAE

Subfamily MILTOGRAMMINAE

The Miltogramminae are a group of Muscoid flies closely related both to the Tachinidae and the Sarcophagidae, but in both morphology and habits, more closely resembling the latter. The adults may be distinguished from any Tachinidae that have come under my observation, by the presence of an undivided postscutellum (fig. 1, *B*, *mt*², compare with *A* and *C*) the possession of an enlarged second sternite which overlaps the tergite of the first abdominal segment[1] on the sides (fig. 2, *B*, *2s*, compare with *A* and *C*). From the Sarcophaginae they may be distinguished, usually, by the Tachinid habitus, and by the arista, which is naked or at most with inconspicuous plumosity scarcely longer than the thickness of the arista. The outer forceps of the male genitalia are usually several times as long as wide and approximate or exceed the inner forceps in size; whereas in the Sacophaginae they are reduced to the so-called "accessory plate."

The Miltogramminae of North America may be divided into two tribes on the following adult characters:

1. Impression of the bucca, near the vibrissal angle, large, conspicuously submerged below the surface level of surrounding sclerites, color of impression usually contrasting conspicuously with that of the parafacials and remainder of bucca; orbital bristles present on females, but usually lacking on males; mesotibia on outer front surface near the middle usually with more than one macrochaeta ..... Tribe **Amobiini**

Impression of bucca, near vibrissal angle, small, not deeply submerged or conspicuously differentiated by color from the parafacials and the remainder of the bucca; orbital bristles present in both sexes or lacking in both males and females; mesotibia on outer front surface near the middle with never more than a single marcochaeta; sternopleuron at most with two bristles; abdomen without discal macrochaetae ..... Tribe **Miltogrammini**

[1] Actually the second abdominal tergite, the first having been reduced to a vestigial sclerite. Most taxonomic workers in calypterate *Muscoidea* refer to the first plainly visible segment as the first abdominal segment, which is the procedure adopted in this paper. Compare Young, Cornell Agricultural Experiment Station, Mem. 44, figs. 38 to 76, 1921.

Tribe MILTOGRAMMINI

Small to medium sized flies, usually with rather short wings and a short, conical abodmen. Ocellar bristles usually differentiated, proclinate. Orbital bristles present in both sexes except in *Pachyophthalmus*, in which they are submerged in a second row of frontals; but one frontal row of bristles on either side of vitta, except in *Pachyophthalmus*. Penultimate joint of arista not more than twice as long as wide. Bucca and back of head about the oral cavity never with a distinct white beard, at most with sparse pale hairs. Eyes bare. Abdomen always bearing macrochaetae. Females with nonpiercing larvipositors. Male genitalia (pls. 1–3) with penis not so highly chitinized nor so intricately sculptured as in typical Sarcophaginae; comparatively small and unspecialized, tipped with a membraneous, more or less collapsible hood; two pairs of claspers present, the posterior clasper usually bearing a stout bristle. Apical cell (pl. 4, fig. 24) ending far before the extreme tip of the wing, sometimes closed at margin of wing but never long petiolate. Fourth vein with a strong fold at the bend.

FIG. 1.—VARIATION IN THE STRUCTURE OF THE MEDITERGITE OR POSTSCUTELLUM. LATERAL ASPECT. *A*, TACHINIDAE (TACHINA MELLA WALKER), *B*, MILTOGRAMMINAE (SENOTAINIA TRILINEATA VAN DER WULP), *C*, SARCOPHAGINAE (SARCOPHAGA COMMUNIS PARKER); *mt*², POSTSCUTELLUM *sl*², SCUTELLUM, *2t* FIRST ABDOMINAL SEGMENT. *A*, AND *C* ADAPTED FROM YOUNG.

The females in all species that have been studied, possess a very short uterus (pl. 4, figs. 20, 22, 25), from which arises a large pouch, in which the ova develop to large, naked, active maggots, of which there is only a moderate number. The female reproductive organs conform in all species studied to the Group III of Pantel,[2] and the somewhat more restricted Metopiine series of Townsend.[3]

The larvae in all instars resemble the unspecialized Muscoid maggot in general appearance. The first instar maggots are metapneustic, the posterior spiracle being at the bottom of a depression; the buccopharyngeal apparatus (pl. 5, figs. 29–34) consists of a single large, heavily chitinized, median hook, articulating with a slender dorsal rod of the intermediate region, and two much weaker, thinly chitinized lateral hooks, one on either side of the median; the intermediate region is fused to the basal piece without articulation. The second and third instar maggots are amphipneustic, the anterior spiracle (pl. 5, fig. 28) consisting of several fingerlike papillae radiating like the rays of a fan. In the last two instars, the median hook of

[2] Diptères à larves entomobies, LaCellule, vol. 26, p. 57, 1910.
[3] An. Ent. Soc. Amer., vol. 4, p. 130, 1911.

the buccopharyngeal apparatus (pl. 5, fig. 34) is absent or vestigial, and the two divergent lateral hooks are strong and heavily chitinized; two articulations, one between the hooks and the intermediate piece and another between the intermediate piece and the basal piece, are present; and above the intermediate region is a small rodlike dorsal accessory piece.

The puparium (pl. 4, fig. 21) is smooth and evenly rounded save at the anterior end which sometimes shows distinct segmentary folds, and the posterior end which is somewhat constricted and truncate at the apex. At the anal end there is usually a deep pit (pl. 5, fig. 27), in which the posterior spiracles are located. The spiracle is pierced by three nearly straight, more or less converging slits.

The adults occur on barren sand, rocks, denuded soil, or less frequently on herbaceous vegetation and low shrubby foliage. Some

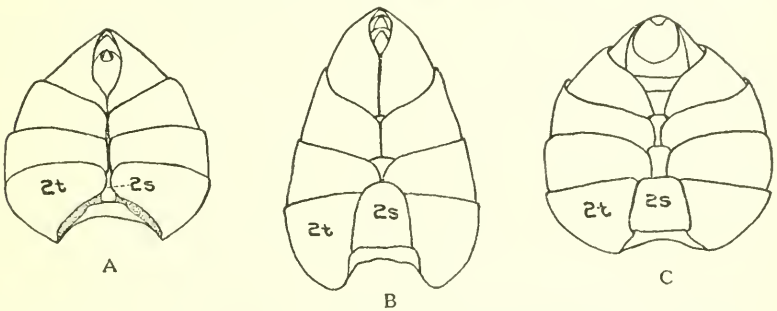

FIG. 2. VENTRAL VIEW OF ABDOMEN TO SHOW VARIATION IN THE DEVELOPMENT AND POSITION OF THE SECOND STERNITE. *A*, TACHINIDAE (FRONTINA ALETIAE RILEY), *B*, MILTOGRAMMINAE (SENOTAINIA TRILINEATA VAN DER WULP), *C*, SARCOPHAGINAE (SARCOPHAGA, SPECIES), *2t* TERGITE OF FIRST SEGMENT, *2s*, SECOND STERNITE REDUCED AND SUBMERGED BENEATH TERGITE IN TACHINIDAE, ENLARGED AND OVERLAPPING TERGITE IN MILTOGRAMMINAE AND SARCOPHAGINAE.

are attracted to flowers, others to the flow of honey dew from aphids or other Hemipterous insects. The females are viviparous, depositing active, motile maggots on or near their food. The maggots live in the nests of fossorial Hymenoptera, feeding on the stores provided for their young, which may be paralyzed insects or spiders, or masses of pollen. The maggots are not known to be primary parasites of the young of their Hymenopteron hosts, though their presence in the nests frequently results in the death of the latter. So far as I am aware, it has not yet been conclusively demonstrated that any of these flies are the primary parasites of phytophagous insects in their native habitat. All the records investigated by the writer indicate that while the flies do breed in the bodies of such hosts, they display no interest in them until after they have become the prey of some wasp.

KEY TO NORTH AMERICAN GENERA OF MILTOGRAMINI

1. First vein bare ..... 2.
   First vein bristly; distal section of fifth vein more than half as long as preceding section; parafacials bearing a distinct row of macrochaetae, facial ridges nearly parallel ..... **Opsidiopsis** Townsend.
2. Length of head at vibrissae almost equal to length at base of antennae; epistoma usually produced, and in profile conspicuously visible ..... 12.
   Length of head at vibrissae much less than at base of antennae; epistoma not produced, at most scarcely visible in profile ..... 3.
3. Apical cell open at margin of wing ..... 5.
   Apical cell closed at margin of wing ..... 4.
4. Distal section of fifth vein longer than preceding section; fold of fourth vein longer than discal cell ..... **Taxigramma** Perris.
   Distal section of fifth vein scarcely more than half as long as preceding section; fold of fourth vein distinctly shorter than discal cell ..... **Hilarella** Rondani.
5. Facial ridges with bristly hairs or macrochaetae which extend not more than one-fourth the distance from the vibrissae to the base of the antennae ..... 6.
   Facial ridges with strong macrochaetae which extend more than half the distance from the vibrissae to base of antennae; vibrissae and ocellar bristles distinctly differentiated; bristly hairs on either side of frontal vitta below ocellus ..... **Sphenometopa** Townsend.
6. Parafacials with a distinct row of macrochaetae ..... 11.
   Parafacials without macrochaetae ..... 7.
7. Abdomen elongate conical; macrochaetae on abdomen much larger than the bristly hairs ..... 8.
   Abdomen subglobose; macrochaetae on abdomen scarcely differentiated from the surrounding bristly hairs; head in profile with no definite angle between buccal and facial margin ..... **Oestrohilarella** Townsend.
8. Frontal rows not extending to below base of antennae and not strongly divergent below; lunule scarcely visible ..... 9.
   Frontal rows extending to middle of second antennal joint and strongly divergent below; lunule conspicuously exposed.
   Phrosinella Robineau-Desvoidy.
9. Third vein on upper surface with but one or two small hairs near its base; arista thickened to near its tip ..... **Senotainia** Macquart.
   Third vein on upper surface usually with a row of bristles extending at least nearly halfway to the small cross vein; if not, arista not thickened beyond basal half ..... 10.
10. Apical scutellar bristles well developed, nearly or quite as large as the extreme lateral scutellars; front with sides not converging anteriorly; male genitalia, in repose, largely or wholly concealed within tip of abdomen.
    Gymnoprosopa Townsend.
    Apical scutellar bristles lacking, or if present, much smaller than the other two pairs of marginals; front with sides usually converging anteriorly; male genitalia, in repose, extruding prominently from tip of abdomen.
    Eumacronychia Townsend.
11. Facial ridges strongly divergent; vibrissae much less than length of second antennal joint above front edge of oral margin; proboscis much shorter than height of head ..... **Metopia** Meigen.
    Facial ridges parallel; vibrissae at least length of second antennal joint above front edge of oral margin; proboscis at least nearly as long as height of head.
    Opsidia Coquillett.

12. Facial ridges usually with bristly hairs; macrochaetae if present, not extending on ridges above tips of antennae ..... 13.
Facial ridges with a row of macrochaetae extending far above tips of antennae. **Sphenometopa** Townsend.
13. A single row of frontal bristles on either side of frontal vitta; orbital bristles present ..... 14.
Two rows of frontal bristles on either side of frontal vitta; orbital bristles absent ..... **Pachyophthalmus** Brauer and Bergenstamm.
14. Distance from tip of antennae to vibrissae equal to or exceeding length of second antennal joint; antennae extending scarcely more than halfway from their base to front edge of oral margin; posterior, convex part of sternopleuron triangular in outline; mesothoracic spiracle with both fringes of about equal size, the posterior one not plumose ..... **Senotainia** Macquart.
Distance from tips of antennae to vibrissae distinctly less than length of second antennal joint; antennae more than two-thirds distance from their base to front edge of oral margin ..... **Eumacronychia** Townsend.

DESCRIPTIONS OF GENERA AND SPECIES

Genus PACHYOPHTHALMUS Brauer and Bergenstamm

Pachyophthalmus Brauer and Bergenstamm, Denkschr. Akad. Wien., vol. 56, p. 117, 1889; vol. 60, p. 170, 1893. Genotype, *Tachina signata* Meigen.—Coquillett, U. S. Bur. Ent., Tech. Ser., no. 7, p. 79, 1897.—Adams, in Williston's North American Diptera, pp. 372, 373, fig. 151, nos. 72, 75, 1908.—Thompson, Paris Edition du Bull. Biol. de la France et de la Belgique, Recherches sur les Diptères parasites, pp. 138–149, 1921.
Sarcomacronychia Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 100, 1892. Genotype, *S. unica* Townsend, which equals *P. floridensis* Townsend, according to J. M. Aldrich, who has examined both of Townsend's types.

The genus is represented in North America by four closely related species. The adults in general appearance closely resemble *Sarcophaga* adults. Other characters are as follows:

The inner eye orbits are broadly convex, without sinuosity, somewhat more nearly approximated at base of antennae than at the vertex, diverging rapidly to bucca; front much narrower than either eye, slightly narrower in female than in male; two frontal rows on either side of vitta, the inner row scarcely attaining base of antennae, and not suddenly divergent below, composed of larger bristles than those of outer row; no orbital bristles in either sex; vibrissae high above front edge of oral margin; antennae short, extending scarcely more than halfway to the oral margin; third joint less than three times the second; penultimate joint of arista not more than twice as long as broad; length of head at vibrissae nearly equals length at base of antennae; facets of eye at extreme front very much larger than those at the side; bucca and back of head beset with black bristly hairs; no pale hairs present. Thorax with three broad, conspicuous black vittae; two sternopleurals, and three pairs of nearly equal marginal scutellar bristles. Intermediate abdominal segments marked with large, irregular blackish spots. Genitalia of male

moderately large; in repose protruding but slightly from tip of abdomen; inner forceps divergent from near their base; posterior claspers bearing bristles; penis with a more or less rigid, noncollapsible, heavily chitinized hood; genitalia of female consisting of a relatively unspecialized larvipositor, telescoped within abdomen in repose. Wings lacking costal spine; veins without bristles save a few at base of third vein; apical cell narrowly open, ending far before extreme wing tip; section of fourth vein beyond the bend strongly arcuate; last section of fifth vein much less than half the preceding section. Pulvilli of male nearly or quite as long, of female much shorter than last tarsal joint.

Townsend [4] dissected one species of the genus and found that it possessed the typical double-pouched uterus of Miltogramminae. The writer has dissected dried specimens of *floridensis*, finding in them considerable numbers of maggots, indicating that the females deposit active larvae. Not all the larvae found were fully formed, a definite series from partly to fully developed first instar maggots being present.

Thompson's description and figures of *signatus* [5] indicates that in the first instar larvae, the cuticle covering, save near the mouth, takes the form of oval or polygonal, convex rugosities differing from the covering of flattened scales followed by longitudinal ribs found in *Miltogramma* and *Senotainia*. The buccopharyngeal apparatus of *signatus*, as figured by Thompson, closely resembles that of *Senotainia*, excepting that the whole mechanism is more massive and the median hook lacks the ventral denticle. I find that the buccopharyngeal apparatus of *floridensis* differs slightly from Thompson's figure for *signatus* in possessing a more slender intermediate piece and differently shaped lateral hooks. Thompson finds that the buccal armature of the third instar very closely resembles that of *Sphecapata conica* and *Miltogramma punctatum;* that there are seven radiating papillae on the anterior spiracle, and that the posterior spiracle possesses the usual three oval slits.

The puparium of *floridensis* has been carefully described and figured by Greene,[6] who finds that the posterior end bears a small, deep pit, within which occur the posterior spiracles. The three slits of the spiracle are straight and parallel, pointed at the lower end, below which is the large round button. The pit is located largely below the horizontal bisecting plane, the anal opening being outside of and below the pit. Thompson noted that the puparium of *signatus* lacks the anal pit, an unexpected aberration verified by the writer in North American specimens in the National Museum.

[4] An. Ent. Soc. Amer., vol. 4, p. 130, 1911.
[5] Recherches sur les Diptères parasites, p. 112, 1921.
[6] Proc. U. S. Nat. Mus., vol. 60, p. 12, fig. 8, 1921.

Pachyophthalmus is represented by a limited number of species occurring in Europe and the American continents. The adults apparently do not frequent barren sand and denuded ground. They are attracted to flowers, bask on shrubby foliage in the sunlight, and have been noted about habitations, as would be expected from the peculiar host relationships. The members of the genus, so far as known, are biologically superimposed on wasps which build mud nests under shelter or in hollow stems, including members of the families Sphecidae and Eumenidae. The manner in which the female establishes her progeny and the subsequent larval development have not been observed. Rau found the puparia of one species lodged in a hollow stem containing the nests of *Odynerus*. When associated with the common "dirt daubers" *Pelopaeus* and *Trypoxylon*, which build their nests indoors, it is not known whether the maggots pupate within the mud cells of their hosts or leave them to seek other shelter for the transitional stage. The members of the genus *Pachyophthalmus* are more distinctly aerial in habit than the other North American genera of Miltogrammini. So far as is known, all of the activities of adult, larval, and pupal stages take place in a stratum extending from a foot or more to several feet above the ground. This is a noteworthy biological specialization in a group of flies, most of which pass the immature stages under ground, and never rise, as adults, but a few inches above the ground.

KEY TO NORTH AMERICAN SPECIES OF PACHYOPHTHALMUS

1. Thoracic vittae not continuous over scutellum; hind tibia on outside with a complete row of bristles extending to the apex; the fourth abdominal and genital segments wholly black ..... 3.
   Thoracic vittae continuous over scutellum; hind tibia on outside with a row of bristles not extending far beyond the middle ..... 2.
2. Fourth abdominal segment and genital segments wholly black; parafrontals outside the two frontal rows conspicuously setulose ..... **hinei**, new species.
   Fourth abdominal segment and genital segments yellow; parafrontals outside the two frontal rows, at most with scattered microscopic bristly hairs ..... **floridensis** Townsend.
3. Anterior clasper of the male genitalia much shorter than the penis, and with bluntly pointed tips ..... **signatus** (Meigen).
   Anterior clasper of the male genitalia nearly as long as the penis, and with exceedingly sharp, delicate, incurved hooks at the tip. ..... **distortus**, new species.

UNRECOGNIZED SPECIES OF PACHYOPHTHALMUS

erythrura VAN DER WULP, Biol. Cent.-Amer., Dipt., vol. 2, p. 89, 1890. Described from a single male from Presidio, Mexico, and assigned to *Miltogramma*. Type in British Museum.

sarcophagina VAN DER WULP, Biol. Cent.-Amer., Dipt., vol. 2, p. 90, 1890. Described from a female from Atoyac, Vera Cruz, Mexico, and assigned to *Miltogramma*. The type and one other specimen in British Museum.

PACHYOPHTHALMUS FLORIDENSIS Townsend

Pachyophthalmus floridensis Townsend, Ent. News, vol. 3, p. 80, 1892; An. Ent. Soc. Amer., vol. 4, p. 130, 1911.—Coquillett, U. S. Bur. of Ent., Tech. Ser., No. 7, p. 80, 1897.—Smith, Ins. of New Jersey, p. 778, 1909.—Aldrich, Cat. of N. A. Dipt., p. 447, 1905.—Johnson, Bull. Amer. Mus. Nat. Hist., vol. 32, art. 3, p. 72, 1913.—Walton, Proc. U. S. Nat. Mus., vol. 48, p. 182, 1914.—Reinhard, Ent. News, vol. 30, p. 283, 1919.—Cole and Lovett, Proc. Cal. Acad. Sciences, vol. 11, p. 301, 1921.

Sarcomacronychia unica Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 101, 1892.

Sarcomacronychia sarcophagoides Townsend, Canad. Ent., vol. 24, p. 165, 1892.

Sarcomacronychia trypoxylonis Townsend, Bull. Ohio Exp. Sta., Tech. Ser., 1, p. 165.

Sarcomacronychia trivitatta Townsend, Proc. U. S. Nat. Mus., vol. 43, p. 363, 1912, type from Peru deposited in U. S. National Museum, examined by me.—Rau and Rau, Wasp Studies Afield, p. 331, 1916.

Male.—Front at narrowest point 0.25 of extreme width of head (measurements of five as follows: 0.22, 0.23, 0.24, 0.27, 0.27); frontal vitta narrowest near middle, where it is one-half to three-fifths width of parafrontals; parafrontals silvery pollinose, outside the frontal rows bare or with sparse microscopic bristly hairs; vibrissae the length of the second antennal joint above front edge of oral margin; facial ridges bristly on lowest half; third antennal joint one and one-half times length of second; arista thickened on basal fourth; penultimate joint slightly longer than broad; proboscis almost equals the head height; labella small and laterally compressed; palpi black. Thorax with the usual three black vittae, extending over the scutellum; three postsutural dorsocentral bristles; scutellum with three nearly equal marginal bristles and small preapicals. Abdomen black excepting the last segment which is red; the three posterior segments thinly gray pollinose, usually to the apex; the intermediate segments with three large, more or less rectangular black spots; first segment bearing strong median marginal bristles; second with median marginals and several lateral bristles, which become weaker as they approach the median line; third and fourth with a marginal row of eight to twelve. Genital segments rufous (pl. 2, fig. 12); inner forceps nearly straight when viewed from the side; outer forceps pale yellow, much less massive than the inner pair, apical two-thirds slender and rounded in cross section; penis with a black, laterally compressed, heavily chitinized hood, consisting of a large, irregular anterior process and a small slender posterior process connected by a narrow translucent membrane; anterior claspers much shorter than the penis, tapering forward to a strong blunt point. Wings with one or two small bristly hairs near the base of the third vein; penultimate section of the fourth vein equaling one-half the preceding section. Pulvilli longer than last tarsal joint; hind tibia on the outside, with an incom-

plete irregular row, of which the lowest is the largest and is located slightly beyond the middle.

Female.—Front at narrowest point 0.19 of head width (measurements of six as follows: 0.14, 0.18, 0.18, 0.19, 0.22, 0.23). With the usual sexual differences in the genitalia and length of pulvilli. Otherwise like the male.

Length, 5 to 9 mm.

Redescribed from a long series including both males and females, from the following localities: Lafayette, Indiana; Blue Ridge Summit, Pennsylvania; Clementon, New Jersey; Chesapeake Beach and Plummer Island, Maryland; Rock Creek Park, District of Columbia; Potomac Creek, Virginia; Wilmington County, Georgia; Miami and Lake Worth, Florida; Victoria, Waco, and Brownsville, Texas; Colorado; Minot, North Dakota; Moscow, Idaho; Emigration Canyon, Utah; Rio Aravaipa, East Verde River and Cave Creek Canyon, Chiricahua Mountains, Arizona; Socoro, New Mexico; Santa Cruz Mountains, Santa Clara County, Los Angeles County, and Claremont, California; Kaslo, British Columbia; Porto Bello, Panama; Boracoa, Cuba; specimens from Lafayette, Indiana, labelled "on parsnip flower," (J. M. Aldrich); "from cells of *P. cementarius*" Dorchester County, Maryland, (H. S. Barber); "from nest of *P. cementarius*," Biloxi, Mississippi; "from the nest of *harrisi*" (F. M. Jones); "from the nest of wasp *Sceliphron cementarium* Dr. var."; Toboga Island, Panama, (J. Zetek); all the above in the collection of the United States National Museum. Baldwin, Kansas; Columbus, Ohio; in collection of Prof. J. S. Hine. Agricultural and Mechanical College, Sellers, and Ocean Springs, Mississippi, in my collection.

The conclusions of Aldrich [7] who examined the types, and of Coquillett [8] as to the identity of Townsend's (*sarcophagoides*) (*trypoxylonis*) (*unica*) and *floridensis* has been accepted without further study of the types. Major Austen of the British Museum, who has compared a specimen of *floridensis* determined by me with the type of (*Miltogramma*) *erythrura* Van der Wulp, states that the latter is a *Pachyophthalmus* but questions whether it is identical with *floridensis*. He adds that "your specimen is little more than half the size of the type, but in spite of this, and the fact that your specimen is a female, while the type is a male, the enlarged facets in the eyes of your specimen are somewhat larger than the corresponding facets in the eyes of the type. Again, the frontal stripe is black in your specimen, but russet in the type in which the black markings on the first three abdominal tergites are less extensive and less clearly defined than in the specimens forwarded by you." I find that in *floridensis*, the size, color, and distribution of pollen are characters variable to a

[7] Cat. of N. A. Dipt., p. 447. [8] U. S. Bur. of Ent., Tech. Ser., No. 7, p. 80.

considerable degree, and that the females possess distinctly larger eye facets than the males, and believe that the differences noted by Major Austen may not be of specific significance. *Miltogramma sarcophagina* Van der Wulp, according to Major Austen, who has recently examined the type for me, is certainly a *Pachyophthalmus*. According to the original description, it has a red-tipped abdomen, a character not possessed by any other species of *Pachyophthalmus* known to me, except *floridensis*. It seems possible that *floridensis* is identical with *erythrura* or *sarcophagina* of Van der Wulp, or with both, but I hesitate to submerge *floridensis* in synonomy until after a more careful comparison of types.

PACHYOPHTHALMUS HINEI, new species

Male.—Front at narrowest 0.27 of head width, (measurements of five as follows: 0.26, 0.26, 0.27, 0.27, 0.28); face and front white pollinose, becoming leaden towards vertex; frontal vitta red, sometimes black, narrowest in front of middle, where it is from less than half to two-thirds as wide as either parafrontal; about 12 bristles in the inside frontal row; parafrontals outside the second frontal row, and as far as base of the antennae, black setulose; vibrissae inserted slightly less than length of second antennal joint above front edge of oral margin; facial ridges with scattered bristly hairs on slightly more than lowest half; antennae black, third joint scarcely longer than second; arista thickened on basal two-fifths, penultimate joint conspicuous and nearly twice as long as wide; parafacials bare; in profile, width of bucca equals width of parafacial and one-eighth eye height; palpi black. Thorax gray pollinose, with three broad black vittae continuous over the scutellum; two, and sometimes three, postsutural dorsocentral bristles; three nearly equal marginal scutellars; no preapicals. Abdomen black, strongly tinged with bronze, densely overlaid with gray pollen, with an obscure, broad, black, median vitta; first segment without median marginal bristles, second with a median marginal pair, third and fourth with uninterrupted marginal rows. Genitalia black, small and fully concealed within the abdomen, in repose; first genital segment without apical macrocahetae; claws of inner forceps nearly straight in profile and terminating in blunt, laterally compressed tips; outer forceps as long and massive as the inner pair, tapering moderately to broad, rounded, polished black tips; penis with the hood largely membranous, consisting of a slender, heavily chitinized stem which extends to apex and supports a posterior, laterally compressed membranous wing which gives to the hood a lanceolate appearance. Wings hyaline; third vein with one to two small bristles at its base. Legs black; pulvilli of fore feet almost as long as last tarsal joint; hind tibia on outside with a row of about eight unequal bristles not extending far beyond the middle.

Female.—Front at narrowest, 0.25 of head width, in the single specimen measured. Pulvilli of fore feet less than one-half length of last tarsal joint. Otherwise, save for usual differences of genitalia, like the male.

Length, 6 to 8 mm.

Type.—Male, in the collection of Prof. J. S. Hine, from Cameron, La. August 14–28, 1903.

Allotype.—Female, in the collection of Professor Hine, same locality and date as the type.

Host relationships.—Unknown.

Described from two males and one female from Cameron, La., August 14–28, 1903, and three males from the same locality, July 7, 1905, all collected by Professor Hine, in whose honor the species is named.

The species is closely allied to *floridensis*, from which it may be distinguished by the absence of red on the last abdominal segment and the genitalia, the absence of preapical scutellars and median marginal bristles on the first abdominal segment, and in having the parafrontals setulose outside the frontal rows.

PACHYOPHTHALMUS SIGNATUS (Meigen)

Tachina signata MEIGEN, Syst. Beschr., vol. 4, p. 303, 1824.
Tachina anomalus ZETTERSTEDT, Dipt. Scand., vol. 13, p. 6074, 1859.
Macronychia signata SCHINER, Faun. Aust., vol. 1, p. 502, 1862.
Pachyophthalmus signatus BRAUER and BERGENSTAMM, Denkschr. Akad. Wien., vol. 56, pl. 7, fig. 145, 1889; vol. 61, p. 620, 1894.—COQUILLETT, U. S. Bur. Ent., Tech. Ser., No. 7, p. 79, 1897.—STEIN, Entom. Nachricht, vol. 26, p. 149, 1900.—VILLENEUVE, Bull. Soc. entom. France, 1900, p. 381.—BEZZI and STEIN, Kat. Pal. Dipt., vol. 3, p. 518, 1907.—SMITH, Ins. New Jersey, p. 778, 1909.—BRIMLEY, Ent. News, vol. 33, p. 24, 1922.
Pachyophthalmus aurifrons TOWNSEND, Trans. Amer. Ent. Soc., vol. 18, p. 354, 1891.
Miltogramma signata PANDELLÉ, Rev. entom., vol. 14, p. 298, 1895.

For this species the writer has accepted the synonomy of Coquillett and Bezzi and Stein without examination of the types concerned. The identity of the European with the North American form has been verified by a comparison of the genitalia.

Male.—Front at narrowest 0.215 of the head width (measurements of four as follows: 0.21, 0.21, 0.21, 0.23); frontal vitta dull black, narrowest at base of antennae; at the middle of front, almost as wide as either parafrontal; inner frontal row of about thirteen bristles; parafrontals golden pollinose; vibrissae two-thirds length of second antennal joint above front edge of oral margin; facial ridges irregularly bristly on lower half or less; antennae black, third joint slightly longer than second; arista thickened on basal third; in profile, buccal width equals parafacials and one-sixth the eye height; front projects about one-fourth the eye diameter; proboscis slender, almost equaling

head height; labella rather small; palpi black. Thorax with the usual three broad black vittae extending as far as scutellum, the latter shining black, without vittae. Abdomen black, with the last three segments thinly gray pollinose, often to their apices; intermediate segments each with three large black spots; strong median marginal bristles on the first two segments, marginal rows of about eight on the last two. Genital segments black; inner forceps (pl. 3, fig. 13) curved forward, tips laterally compressed; outer forceps yellow, tapering to points round in cross section, more slender than inner forceps; penis with black, heavily chitinized hood, bootlike in appearance, with the toe of the "boot" pointed towards the inner forceps and with a transparent keel on its posterior border; anterior clasper slightly more than half as long as penis, tapering to a stout, anteriorly directed point. Wings with two to three small hairs at base of third vein. Legs black; hind tibia with a complete row of uneven bristles on the outside surface.

Female.—Not distinguished with certainty from females of *P. distortus*. The front at narrowest, in five specimens averaged 0.18 of the head width (measurements as follows: 0.15, 0.16, 0.17, 0.22, 0.22). Usual sexual differences in genitalia and in length of claws and pulvilli. Otherwise like the male.

Length, 6 to 7 mm.

Redescribed from the following males: One from Holyoke, Massachusetts, no. 1478c Dimmock's Ent. Notes; three from Washington, District of Columbia, one labeled "from wasp's nest" (H. G. Dyer); one labeled "from butter wasp" (C. V. Riley); four from Lafayette, Indiana (J. M. Aldrich); two from Tennessee Pass, Colo. (J. M. Aldrich); three from White Mountains, New Mexico, two labeled "flowers of *Cicuta occidentalis*" and the other "flowers of *Solidago trinervata*" (C. H. T. Townsend); two from Mono Lake, California (J. M. Aldrich); two from Sierra Madra, Chihuahua, Mex. (C. H. T. Townsend); all in the collection of the National Museum. One from Sugar Grove, Ohio, and another from Columbus, Ohio, labeled "parasite of *Trypoxylon politum*," both in collection of Prof. J. S. Hine. One male, Macerat, Italy (?), determined by Professor Bezzi, and one male, Rambouillet, France. Both European specimens in which the genitalia was relaxed were found to be identical with North American material.

Owing to the inclusion of two distinct species under the name *signatus*, published records referring to this species up to the present should not be accepted without verification. *P. signatus* occurs in Europe and is also generally distributed over North America, having been identified by the writer from males with the genitalia relaxed, from Massachusetts, District of Columbia, Indiana, Colorado, New Mexico, California, and Chihuahua, Mexico. It is attracted to

flowers, Townsend having taken specimens in the Southwest on *Cicuta occidentalis* and *Solidago trinervata*. The writer on one occasion, captured several specimens basking on sunlit foliage of shrubs and small trees in Massachusetts. I have examined one specimen bearing a record of rearing from *Trypoxylon politum* Say. The host relationships indicated by Coquillett,[9] Brimley,[10] and Malysev[11] are possibly correct but should be verified.

PACHYOPHTHALMUS DISTORTUS, new species

Male.—Front at narrowest 0.22 of head width (measurements of five as follows: 0.20, 0.21, 0.21, 0.23, 0.24); frontal vitta black, narrowest near the middle, where it is about two-thirds width of parafrontal, diverging slightly to vertex; parafrontals with a dense inner row of about fifteen bristles, outside of which is a row of smaller bristles and sparse, scattered hairs; vibrissae about half length of second antennal joint above front edge of oral margin; antennae black, extending two-thirds distance to vibrissae, third joint slightly longer than second; arista thickened on basal third; penultimate joint nearly twice as long as wide; facial ridges with scattered hairs on lower half; in profile, bucca wider than parafacials and equal to about one-sixth the eye height; front projects about one-fourth eye diameter; parafacials bare save for a few sparse hairs; proboscis about two-thirds head height, stout; labella fleshy; palpi black. Thorax gray pollinose, with the usual three broad black vittae extending as far as the scutellum; three, or sometimes four postsutral dorsocentral bristles; scutellum with three marginals, of which the intermediate pair is larger than the other equal pairs. Abdomen black, densely gray pollinose to apices of segments with three large, shining, irregular black spots on each of the last three segments; first and second with strong median marginal pair of bristles and a few laterals becoming weaker towards the median line; third and fourth segments with marginal row of fourteen to sixteen bristles. Genitalia (pl. 3, fig. 14) black; inner forceps slightly divergent from their base; claws moderately flattened laterally, in profile curved abruptly forward near the tip; outer forceps tapering uniformly to rounded tips about equal to size of tips of inner forceps; penis laterally compressed, with the rolled edges of apical aperture much narrower than width of penis in the middle; anterior claspers nearly as long as the penis, extremely crooked, with very fine hooked tips, best seen from the rear. Wings of usual venation; third vein with two to three small hairs at its base. Legs black; hind tibia with complete row of about nine irregular bristles on outer surface.

[9] U. S. Bur. Ent., Tech. Ser., No. 7, p. 19, 1897.
[10] Ent. News, vol. 33, p. 24, 1922.
[11] Hort. Soc. Ent. Ross., vol. 40, p. 51.

Length, 5 to 8 mm.

Type.—Male, Cat. No. 28150, U.S.N.M., from Stone Valley, Pennsylvania.

Described from the following material, all males: In the National Museum; one from White Mountains, New Hampshire (Morrison); four from Stone Valley, Pennsylvania, June 24 (H. E. Ewing); seven from Plummer Island, Maryland, bred from nest of *Trypoxylon politum*, February 25, 1917 (H. L. Viereck); one from Kaslo, British Columbia (R. P. Currie): in the Canadian National collection, two, Barber D., New Brunswick, 24–vi–1914 (F. M. McKenzie) (J. D. Tothill); one, Barber D., New Brunswick, 25–vi–1914 (J. D. Tothill); one, Hamilton River, Muskrat Falls, Labrador, 12–19–vii–1919 (S. E. Arthur): in the collection of R. C. Shannon, one from Ithaca, New York, May 25, 1922.

The female, I have been unable to distinguish from those of *P. signatus*. The male also resembles *signatus* excepting in the genitalia which is widely different. *P. distortus* is at present known from only a limited number of localities in the northeastern states, eastern Canada, and from Kaslo, British Columbia. It has never been collected on flowers. Doctor Ewing secured several specimens from a large number observed flying about the porch of a deserted cabin in Pennsylvania. It has been reared from *Trypoxylon politum* Say.

Genus SENOTAINIA Macquart

Senotainia Macquart, Dipt. Exot. Suppl., vol. 1, p. 167, 1846. Genotype, *rubriventris* from Galveston, Tex., not seen; but the original description mentions the presence of a frontal row of eight bristles, three orbitals, a linear frontal vitta and red abdomen, distinctive of one common North American species widely recognized as *rubriventris*.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 80, 1897; Proc. U. S. Nat. Mus., vol. 37, p. 695, 1910.—Adams, in Williston's Diptera of N. A., p. 373, fig. 152, no. 110, p. 375, (*Miltogramma*), 1908.—Townsend, Smithson. Misc. Coll., vol. 51, p. 56, 1908; An. Ent. Soc. Amer., vol. 4, p. 140, 1911.

Megaera Robineau-Desvoidy, Myod., p. 94, 1830. According to Bezzi and Stein, (Pal. Dipt., vol. 3, p. 515) preoccupied by Wagler for Reptilia, in August 1830, (Isis, 1830, p. 944). No date other than 1830 appears in Desvoidy's publication.

Sphecapata Rondani, Dipt. Ital. Prod., vol. 3, p. 221, 1859. Genotype not designated by Rondani. *S. albifrons* Rondani designated by Brauer and Bergenstamm, Denkschr. Akad. Wien., vol. 56, p. 115, 1889. *S. conica* Fallén designated by Brauer, Vorarb. Monog. Musc. Schizo., p. 58, 1893. But since *albifrons* equals *conica*, (Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 515) the latter becomes the genotype. After careful examination of European specimens of *conica* determined by Professor Bezzi and others, I am unable to distinguish any characters of generic importance separating this species from *Senotainia*.

Miscllia Robineau-Desvoidy, Dipt. Env. Paris, vol. 2, p. 146, 1863. Genotype designated is *Megaera dira* Robineau-Desvoidy which according to Desvoidy's own statement equals *Miltogramma conica* Fallén. But

conica belongs to *Sphecapata* of which it is the genotype, which equals *Senotainia*, an earlier name. Hence *Miscllia* equals *Senotainia*.

Euselenomyia TOWNSEND, Proc. U. S. Nat. Mus., vol. 43, p. 364, 1912. Genotype, *peruviensis* examined by the writer.

Microsenotainia TOWNSEND, Proc. U. S. Nat. Mus., vol. 49, p. 618, 1915. Genotype, *Senotainia nana* Coquillett, examined by the writer.

Eusenotainia TOWNSEND, Proc. Biol. Soc. Wash., vol. 28, p. 22, 1915. Genotype, *Hilarella rufiventris* Coquillett, examined by the writer.

Frontal vitta at most slightly wider than parafrontals; proclinate ocellar bristles present; a single row of frontals not descending below base of antennae and not suddenly divergent below; from two to several pairs of orbital bristles present in both sexes; front slightly narrower in females than in males; arista stubby, penultimate joint at most scarcely twice as long as wide; vibrissae differentiated from other hairs about the mouth; facial ridges without macrochaetae, bristly on not more than lowest fourth; parafacials hairy or not, but never with macrochaetae on lowest half; in profile, head length at vibrissae nearly or quite equals that at base of antennae; proboscis slender, and nearly as long as head height; facets at extreme front several times larger than those at sides of eye; bucca and back of head without pale hairs. Convex, posterior part of sternopleuron triangular in outline; two similar, brush like flaps of hairs close the mesothoracic spiracle, the hind flap not differentiated in the shape of a conspicuous oval plume. Male genitalia (pl. 2 figs. 7, 8, 9, 10, 11) in repose usually protruding somewhat conspicuously from tip of abdomen; penis with membranous spiniferous hood, frequently saclike and collapsible; posterior clasper with a prominent bristle; female genitalia in the form of non-piercing larvipositors telescoped in the abdomen, in repose. Wings (pl. 4, fig. 24) hyaline; apical cell open; last section of fifth vein distinctly less than half the preceding section; veins without bristles save for one to several small ones at base of third vein. Pulvilli of male nearly or quite as long as last tarsal joint and much longer than those of female.

The female reproductive organs of three species have been dissected (pl. 4, figs. 20, 22, 25). In all, the uterus was found to be very short, with a conspicuous pouch-like expansion, containing, in mature specimens, large active larvae. Considerable difference in conformation of the various organs of reproduction was noted in the species dissected but this may have been due more largely to variation of stage of maturity than to specific differences.

First instar maggots of four species have been examined. In all, the cuticle is of about the same texture dorsally and ventrally, and is drawn into flat, longitudinal ribs or corrugations on the posterior two-thirds of each segment. The anterior third of each segment is armed with flat, minute scales, not strongly chitinized and scarcely visible except under a high power objective. The maggots are

metapneustic. The buccopharyngeal apparatus (pl. 5, figs. 30, 31, 32, 33) is moderately strong, the mouth hooks being much shorter and less massive than the basal piece. The median hook is heavily chitinized; the lateral hooks are not fused at the tip with the median hook, but terminate in well defined tips, similar to the tip of the median hook, in outline, but much less strongly chitinized. The median hook articulates with a slender intermediate region which is in turn firmly fused to the basal piece. The sides of the intermediate region are joined ventrally by a sclerite, which in lateral view appears barblike, and which viewed from above gives the region an H-like appearance. The large basal piece consists of a single ventral and two dorsal wings which are not cleft on their posterior margins. This agrees in every particular with Thompson's description of the first instar maggot of *Sphecapata conica*.[12]

S. trilineata is the only species in which the second instar maggot has been studied. The body is white, with transparent cuticle through which the internal organs are plainly visible. The cuticle of the first four segments bears irregular rows of minute black spines confined to an encircling belt on the anterior third of the segment. In this instar, the maggot is amphipneustic, the anterior spiracle terminating in several fingerlike papillae spread fanlike and protruding conspicuously from the body. The buccopharyngeal apparatus differs from that of the first instar maggot in several particulars (pl. 5, fig. 34). There are two strong lateral hooks but no median hook; the intermediate piece articulates freely with the basal piece as well as the bucal hooks; the superior wing of the basal piece has at its posterior margin, two prolongations separated by a deep cleft; and dorsal to the intermediate region is a weak vestigial sclerite called the dorsal accessory piece.

The puparia of three species have been studied (pl. 4, fig. 21). They are characterized as follows: Yellowish to chestnut-brown in color, rather smooth and thin-walled; with minute brown spines on the anterior third or less of the segment, spiniferous areas encircling the segments anteriorly, limited to the ventral surface posteriorly; round in cross section; from the lateral aspect, oval save for the extreme posterior margin which is truncate. Anterior spiracle protruding, terminating in several fingerlike papillae, radiating fanlike from the base; posterior spiracles located in distinct shield-shaped pit (pl. 5, fig. 27), centered on the longitudinal axis; spiracles located at the upper part of the pit, separated by at least their diameter, broadly rounded above, tapering to a point below; button indistinct; anal opening large and located at some distance below the pit.

Several species of this genus are widely distributed over North America, at least one of which occurs as far southward as Peru, in

[12] Recherches Sur. les Diptères parasites, p. 105, fig. 109.

South America. Other species (*Sphecapata*) are widely distributed over Europe. So far as known, the European and New World forms are distinct. In North America the genus ranges from British Columbia and Ontario on the north, to Panama, and is represented also in some of the West Indian islands. This genus appears to be best represented in the fauna of the south and southwestern states, where as many as six species may be present in the same general locality. Northward the number diminishes, and southward in tropical America, also, fewer species are known, though perhaps because that region has been less thoroughly worked. Judging from its presence in collections, the individuals of the genus *Senotainia* are nearly if not quite as abundant as individuals of all other *Miltogramminid* genera combined. In the collection of the writer which is largely from Mississippi and Ohio, over seventy per cent of all Miltogramminae are *Senotainia*, and *Metopia*, with about seventeen per cent, is the genus which most closely approaches it in numbers. A somewhat similar ratio exists in the other large collections studied.

The adults of several species of *Senotainia* are attracted to flowers. Several species of flowers may be visited by one species of fly. Compositae appear to be favored, but the blossoms of other groups are also visited. The writer has never taken them on the blossoms or foliage of trees or high shrubs. It has been noted that in species of *Senotainia* that visit flowers, the proboscis is long and slender, while in *Metopia*, *Sphenometopa*, *Phrosinella*, and other genera in which the adults have never been taken on flowers, the proboscis is very short and stout.

The members of the genus *Senotainia*, so far as known, are biologically superimposed on fossorial Hymenoptera, principally as commensals living on the food provided by the wasps for their young, frequently eliminating the grub of the wasp either by producing unsuitable conditions or by direct predatory act, but probably never as a true endoparasite of the latter. The females deposit large, active, naked larvae, probably in most cases, on or near the paralyzed prey of Hymenopteron hosts, after it has been placed in the burrow. The members of at least three families of Aculeata, Bembicidae, Psammocharidae and probably Sphecidae are attacked by *Senotainia*. All so attacked dig burrows in the soil, some of which are provisioned with spiders, others with flies, Heteropteron nymphs, or other Arthropod prey. From the rather limited rearing records, it would appear that the larvae of *Senotainia* are far less exacting in their food requirements than typical Tachinids, in this respect much more closely approaching the typical Sarcophagidae and Calliphoridae. The conjectures of Townsend[13] as to the larval habits of

[13] An. Ent. Soc., vol. 4, p. 140, 1911.

Senotainia have been largely disproved by actual observations on the larvae of several species, recorded elsewhere in this paper.

The habit of trailing or "shadowing" the host as it carries the prey to its nest seems to be more highly developed in this genus than in any other in the group. This habit appears related to two structural characters not occuring in such a pronounced degree in other North American *Miltogrammini*, excepting in the genus *Pachyophthalmus*, which are, namely, the conspicuously enlarged facets of the front part of the eyes, and the uniformly narrower front and larger development of the eyes in the female as compared with the male. The possession of larger eyes with the enlarged facets, should in all probability be regarded as specializations permitting the female to keep herself oriented more readily with the rapidly moving form of the wasp she follows, while in flight.

So far as observed, the members of this genus display little or no interest in burrows stocked with food, or the paralyzed victims of the wasp, when it drops them outside its burrow, but is strongly excited by the presence of the wasp carrying its prey, and is seemingly stimulated to larviposition only in the presence of this combination.

KEY TO NORTH AMERICAN SPECIES OF SENOTANINIA

1. Sternopleura with one bristle ..... 7.
   Sternopleura with two bristles ..... 2.
2. Abdomen red, at least on the sides; third antennal joint red or at most with blackish tomentum over the red ..... 4.
   Abdomen wholly black ..... 3.
3. The two frontal rows of macrochaetae, at their middle, separated by a distance greater than width of either parafrontal; three distinct postsutural dorsocentral bristles ..... **trilineata** Van der Wulp.
   The two frontal rows of macrochaetae, at their middle, separated by a distance less than width of either parafrontal; not more than two postsutural dorsocentrals differentiated ..... **litoralis** Allen.
4. Second abdominal segment with median marginal bristles ..... 6.
   Second abdominal segment without median marginal bristles ..... 5.
5. Arista thickened almost to the tip; third antennal joint at least nearly three times length of second joint ..... **rufiventris** (Coquillett).
   Arista thickened on basal half; third antennal joint at most scarcely exceeding two times length of second joint ..... **flavicornis** (Townsend).
6. Arista thickened on the basal two-fifths; bucca in profile usually not more than one-twentieth the eye height; two proclinate orbital bristles; outer forceps of male genitalia with a strong rounded hook, directed anteriorly. **rubriventris** Macquart.
   Arista thickened on basal three-fifths; bucca in profile at least one-tenth eye height; usually but one proclinate orbital bristle; outer forceps of male genitalia with stout, sharp tip posteriorly directed and apposed to the tip of the inner forceps ..... **vigilans** Allen.
7. Costa, near the humeral angle, with erect, radiating, bristly hairs; inner forceps of male genitalia broadly triangular when viewed from behind. **setulicosta**, new species.

Costa, near the humeral angle, with appressed hairs; inner forceps of male genitalia elongate and linear when viewed from behind____nana Coquillett.

UNRECOGNIZED SPECIES AND OTHERS MENTIONED BY ALDRICH [14] AND BY COQUILLETT [15]

biscta THOMSON, Kong. Sven. Freg. Eugenies Resa, p. 524, 1868. There is no record of this species since the type was described from Panama in 1868. From the description is seems probable that the species belongs in *Senotainia*, but its exact position is rather uncertain.

erythrocera THOMSON, Kong. Sven. Freg. Eugenies Resa, p. 523, 1868. This species from California is described as possessing a long, pale, shaggy beard, three sternopleural bristles and discal bristles on the fourth abdominal segment—characters sufficient to place it outside the limits of *Senotainia*, and in all probability outside the subfamily *Miltogramminae*.

sarcophagina VAN DER WULP, Biol. Cent. Amer., Dipt., vol. 2, p. 90, 1890. Major Austen reexamined the type in the British Museum for me, finding that the specimen possessed two rows of frontal bristles on each side of the frontal vitta. He writes that it is certainly a *Pachyophthalmus*, to which genus it has been assigned.

erythrura VAN DER WULP, Biol. Cent. Amer., Dipt., vol. 2, p. 89, 1890. Major Austen, who has examined the type in the British Museum for me states that this species is also a *Pachyophthalmus*, to which genus it has been assigned.

fulvicornis VAN DER WULP, Biol. Cent. Amer., Dipt., vol. 2, p. 89, 1890. Described from type and one other female from Guerrero, Mexico, and assigned to *Miltogramma*. Type in British Museum reexamined for me by Mr. Barnett who states that "the type does not possess a pair of marginal bristles at the apex of the second abdominal segment; the tibia of the hind leg is equipped with a more or less complete row of bristles on the outside; there are more than ten bristles in the frontal row on either side of the frontal vitta; the eyes are nearly twice as high as wide." These characters serve amply to distinguish it from *rubriventris* with which it has been considered synonymous. Major Austen states that it is a *Sphixapata*, which equals *Senotainia*. He has compared the type with a specimen of *Senotainia flavicornis* Townsend determined by me which possesses all the characters listed above for the type of *fulvicornis*, and states that they are certainly not conspecific. It does not appear to be identical with any other species discussed in this paper and must represent a distinct species which I am at present unable to place.

nana VAN DER WULP, Tijdschr. v. Ent., vol. 35, p. 195, 1888; Biol. Cent. Amer., Dipt., vol. 2, p. 483, 1903. Described and assigned to *Miltogramma;* type, a female from Guerrero, Mexico, has been lost. I find it impossible to definitely determine the place of this form from the superficial nature of the description. It has not been reported since its description over 35 years ago. It may belong to the genus *Senotainia*, and is most certainly distinct from *nana* Coquillet and other species of the genus mentioned in this paper. Unless the type should be found, the name might best be disregarded.

fasciata COQUILLETT, U. S. Bur. Ent., Tech. Ser., No. 7, p. 81, 1897. Equals *Eumacronychia elita* Townsend.

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[14] Cat. N. A. Dipt., p. 447, 1905.

[15] U. S. Bur. Ent., Tech. Ser. No. 7, p. 80, 1897.

SENOTAINIA FLAVICORNIS (Townsend)

Miltogramma flavicornis Townsend, Trans. Amer. Ent. Soc., vol. 18, p. 355, 1891. Type from southern Illinois.
Miltogramma similis Townsend, Trans Amer. Ent. Soc., vol. 18, p. 357.
Miltogramma kansensis Townsend, Can. Ent., vol. 24, p. 68, 1892.

Male.—Front at narrowest 0.25 of the head width (measurements of five 0.24, 0.24, 0.24, 0.25, 0.28); front and face silvery pollinose; vitta brownish, somewhat pollinose, width at base of antennæ not more than twice the diameter of lowest ocellus, widening to slightly more than width of parafrontal at ocellar triangle; frontal row with 12 to 18 bristles; with one reclimate and usually two, sometimes one, three or even more proclinate orbital bristles; sparse bristly hairs on parafrontals outside the frontal row; antennae red, third joint two to two and one-half times as long as the second; arista thickened on basal half, penultimate joint almost twice as long as wide; parafacials bare; facial ridges bristly on lowest fifth; bristles frequently scattered rather irregularly over the expansion of the facial ridges lateral to vibrissae; in profile, width of bucca is subequal to parafacials, and equal to one-eighth of eye height; eye height almost twice eye width; palpi nearly filiform, scarcely larger than arista, yellow. Thorax thinly gray pollinose over black, with three narrow median vittae not extending beyond transverse suture; caudad of suture, three broad black vittae; two strong sternopleurals, and two postsutural dorsocentrals of which the anterior one is much the weaker; three pairs of marginal scutellars of about equal size. Abdomen black, usually with a lateral red spot involving the second and frequently the third and fourth segments on their sides, separated dorsally by a black vitta; thinly gray pollinose on the bases and surrounding the black polished apices of the last three segments; no median marginal bristles on the first two segments, a marginal row on each of the last two. The inner forceps of the genitalia (pl. 2, fig. 9) are black with rather long slender tips, slightly thinner one-third the distance back than just before the tips; outer forceps nearly as long and as large as the inner, rather broad, with sharply pointed tips directed anteriorly and not apposed to the tip of inner forceps; posterior clasper bearing a long bristle; penis with a spiniferous, membranous hood terminating in a small pendant cylindrical process. Wings with one to five bristles in a tuft at base of third vein. Legs black; middle tibia with a single bristle on outer front side near middle.

Female.—Front at narrowest 0.22 of head width in the single specimen measured; frontal rows not so thickly beset with bristles; third antennal joint one and one-half times as long as second. Genitalia retracted within abdomen in repose. Claws and pulvilli much shorter than last tarsal joint. Otherwise like the male.

Length, 4.5 to 11 mm.

Redescribed from a long series consisting largely of males in the collections of the National Museum, the Museum of Comparative Zoology at Cambridge, Massachusetts, Dr. C. W. Johnson, and the writer from the following localities: Lafayette and Michigan City, Indiana; Algonquin and Carlinsville, Illinois; Maryland; Tifton, Georgia; Georgiana, Florida; West Point and Agricultural and Mechanical College, Mississippi; Kansas; Cambridge, Nebraska; Wild Horse Canyon, Animas, Santa Fe, and Socorro, New Mexico; College Station, Balmorehea, and Galveston, Texas; Powdersville, Montana; Los Angeles County, California; Havana, Cuba; one male, Owen's Lake, California, labeled "on flowers of *Asclepias*" (J. M. Aldrich); one male in the Loew collection bearing an orange label.

The synonomy for this species has been submitted after a careful study of Townsend's types loaned by the University of Kansas Museum. The number of orbital bristles on the types of *similis* and *flavicornis* is variable, even as between the two sides of the same specimen, varying from one to four. In the typical specimen best represented by *kansensis* there are one reclinate and two proclinate orbitals.

It is not unusual to find specimens intermediate between typical *flavicornis* and *rubriventris*, which can not be very satisfactorily placed. In the typical *flavicornis*, the eye is more elongate, the frontal row is more thickly beset with bristles, no median marginals occur on the second segment of the abdomen, the hind tibia on the outside is ciliate with a complete row of short bristles interrupted by one long spine in the middle, and the specimens are usually larger in size.

Owing to the confusion that has long existed between this species and *rubriventris*, our knowledge of the geographical distribution is limited. Specimens have been identified from Maryland, Indiana, Illinois, Georgia, Florida, Mississippi, Kansas, Nebraska, New Mexico, Texas, Montana, California, and Cuba. It has not as yet been identified from the northeastern United States, Canada, or the Central American countries. Nothing is known of the host relationships. The writer found the adults abundant on the blossoms of *Erigeron* in May in north central Mississippi, associated with *S. trilineata*. Since then it has been collected occasionally on cowpea foliage in the same locality. Dr. J. M. Aldrich reports collecting it from flowers of *Asclepias* in California. I have never encountered this species resting on barren soil in the sunlight as do the other common species of the genus. In collections, males far outnumber females, very likely because the normal habitat of the mature female has not yet been discovered.

SENOTAINIA RUBRIVENTRIS Macquart

Senotainia rubriventris Macquart, Dipt. Exot. Suppl., vol. 1, p. 167, 1846. Type from Galveston, Tex.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 80, 1897.—Osborn, Ohio Naturalist, vol. 7, p. 38, 1906.—Smith, Ins. of New Jersey, p. 778, 1909.—Johnson, Bull. Amer. Mus. Nat. Hist., vol. 32, 1913.—Walton, Proc. U. S. Nat. Mus., vol. 48, p. 182, 1914.—Aldrich, An. Ent. Soc. Amer., vol. 8, p. 82, 1915.—Reinhard, Ent. News, vol. 30, p. 284, 1919.—Brimley, Ent. News, vol. 33, p. 25, 1922.

Miltogramma decisa Townsend, Ent. News, vol. 3, p. 81, 1892.

Male.—Front at narrowest 0.25 of head width (measurements of four as follows: 0.25, 0.25, 0.25, 0.26); frontal vitta brown, at base of antennae scarcely twice width of lowest ocellus, widening to two and one-half times width of parafrontal at ocellar triangle; one reclinate and two proclinate orbital bristles; front nearly destitute of bristly hairs; vibrissae length of second antennal joint above front edge of oral margin, separated by distance equal to one and one-half times second antennal joint; facial ridges bare excepting one or two small bristles above the vibrissae; region lateral to vibrissae without scattered bristly hairs; antennae yellow, extending three-fourths distance to vibrissae; third joint one and one-half to two times as long as the second; arista thickened on basal two-fifths, penultimate joint as broad as long; parafacials bare; palpi yellow; in profile, bucca one-tenth to one-twenty-fifth eye height and distinctly narrower than parafacials; eye more than half as wide as high. Thorax gray pollinose over black, with three narrow median vittae; two strong sternopleural bristles present and four postsutural dorsocentrals of which the anterior two are small or absent altogether; scutellum with three pairs of marginals of equal size. Abdomen with intermediate segments and lateral posterior part of first, rufous, the remainder of the first and the fourth black, frequently with a dorsal triangle of black on intermediate segments, last three segments thinly whitish pollinose; second segment bearing a median marginal pair of bristles, third and fourth each with a marginal row of about eight. Genitalia (pl. 2, fig. 8) black, with the appearance, in repose, of being too large to fit into tip of abdomen; inner forceps shining black, moderately short and blunt, with sharp, stout tips, united to apex save for minute apical cleft, in profile, convex on outside, nearly straight inside; outer forceps brown, distinctly shorter than the inner pair, strongly rounded over at the tip into a rather bluntly-pointed hook, directed cephalad like the inner forceps; sides of fifth sternite with angular apex and bearing appressed, bristly black hairs to the tip. Legs black; middle tibia with a single bristle on outside near the middle; hind tibia with a row of four unequal bristles on outside, not extending far beyond middle; hind femur without villosity on inner proximal

surface. Wings without costal spine; third vein with one to two small bristles at its base.

Female.—Front at narrowest 0.25 of head width (measurements of five as follows: 0.25, 0.25, 0.25, 0.25, 0.26); otherwise except for usual sexual differences of pulvilli and genitalia, like the male.

Length, 3.5 to 6 mm.

This species is well represented by both males and females in all collections examined by me. Redescribed from a long series of specimens from the following localities: Massachusetts; Button Woods, Rhode Island; Lahaway, Ocean County, Ocean Grove, New Jersey; Chesapeake Beach, Plummer Island, Maryland; Sandusky, Cincinnati, Blackhand, Ohio; Lafayette, Plymouth, Michigan City, Indiana; Raleigh, Laurel Hill, North Carolina; Georgia; Miami, White Sulphur Springs, Florida; Holly Springs, Starkville, McHenry, Ocean Springs, Mississippi; College Station, Texas; Colorado; Socorro, New Mexico; Ormsby County, Nevada; Claremont County, California; Moscow, Julietta, Idaho; Owl Creek Mountains, Wyoming; Umatilla, Oregon; Sea Cliff, Long Island, labeled "on beach and salt grass"; Koebler, New Mexico, labeled "Webster No. 7707," (W. R. Walton); one female labeled "Parker Note No. 18" and another female, "Parker Note No. 27"; one female, reared from nest of *Bicyrtes quadrifasciata*, Adaton, Mississippi, Aug., 1922, and several males from flowers of *Erigeron*, Agricultural and Mechanical College, Mississippi (H. W. Allen).

The puparium possesses the following characters: Yellowish-brown in color, with small, backwardly-directed spines encircling the anterior part of the thoracic segments, but limited to ventral parts of addominal segments; anal segment without well-developed spines above the depression; from lateral view, broadest at middle, the dorsal and ventral margins convex; anterior spiracle with six papillae; anal depression moderately deep.

This species has been identified by the writer from many localities ranging from Massachusetts, Idaho, and Oregon on the north, to Florida, Texas, and California, indicating that it is generally distributed throughout continental United States. It has been reported in literature from Canada, certain islands of the West Indies, and Mexico, but it should be remembered that other nearly related species have long been confused with this form, hence such records must necessarily be verified before being accepted.

The published records relating to the biology of this species are few and those we have are open to doubt as to the correctness of determination. Professor Osborn's interesting notes on wasp-trailing flies [16] probably refer to *rubriventris*, though they may be referable

[15] Ohio Naturalist, vol. 7, no. 2, p. 38.

to other species of the *rubriventris* group known to be present in the Great Lakes region.

The writer has taken the female in midsummer, on sandy, barren spots in open pasture, and the males in large numbers on the flowers of *Erigeron*, in early spring. One adult has been reared from nests of *Bicyrtes quadrifasciatus* stocked with Heteropteron nymphs, from Adaton, Miss. A small maggot was discovered on July 17 boring into a paralyzed nymph in the nest of the wasp taken to laboratory on July 15. By the following day it had dismembered the nymph and bored into the sand beneath to pupate, and on July 28, the fly emerged. The last part of the larval stage was passed in burrowing in and out of the putrid material, like a typical *Sarcophaga* maggot.

Prof. J. B. Parker has made some interesting observations on the biology of this species in connection with his work on wasps at Washington, D. C. One female, labeled, "Parker Note No. 18," was captured after invading the burrow of *Oxybelus quadrinotatus* Say on June 20, 1914. In another observation, "Parker Note No. 27," he states that on June 24, "a solitary wasp was discovered entering her nest with a grasshopper. A fly dashed into the nest after the wasp and was captured as it came out. The nest was opened at once and found to contain three completed brood chambers, and one incompleted. The incompleted brood chamber contained two grasshoppers each of which bore fly larvae." In one of the completed chambers, with the partly-consumed stock of grasshoppers, "was found a single fat dipterous larva which was taken to the laboratory and placed in a breeding cell." On July 12, 1912, the fly emerged. The wasp was not identified.

SENOTAINIA VIGILANS Allen.

Senotainia vigilans ALLEN, Occas. Pap. Bost. Soc. Nat. Hist., vol. 5, p. 89, 1924.

Type.—Male, Cat. No. 27231, U. S. N. M., from Adaton, Miss.

This species closely resembles *litoralis* Allen from which it differs in having a large amount of red on the abdomen, while the latter is constantly black throughout. In *vigilans* there is usually but one proclinate orbital (pl. 4, fig. 23) and in the male, the sides of the fifth sternite are lobiform, and the hind femur bears villous hairs equalling the thickness of the femur on the proximal third of the under surface. Some specimens of *vigilans* vary toward *rubriventris*. Males of *vigilans* may be readily distinguished by the tips of the outer forceps (pl. 2, fig. 11) which are angular and hooked towards tip of inner forceps, by the lobiform fifth sternite and the villosity of the hind femur. In both sexes of *vigilans*, the bucca and front is wider, the arista more extensively thickened than in *rubriventris*.

Two mature females have been dissected and the reproductive organs examined (pl. 4, fig. 22). The outstanding morphological

characters are as follows: Spermathecal ducts not united, their basal halves conspicuously inflated; accessory glands of equal size, elongate, more than ten times length of their ducts. In the uterine pouch of one, 15 large maggots were counted. With the maggots in the pouches occurred the larval sheaths, evidently sloughed off by the larvae as soon as they became active in the uterus. The sheath was reticulated, more conspicuously so in a belt about the middle. Uterine maggots in the specimens dissected were all at about the same stage of development.

Several first instar uterine maggots have been examined. In the buccopharyngeal apparatus (pl. 5, fig. 33) were found the only readily recognized specific characters. The median hook is broad to the middle, thence suddenly constricted to a fine, slightly curved point, ventral tooth lacking; lateral hooks moderately curved but not definitely hooked.

The puparium (pl. 4, fig. 21) is chestnut-brown in color, with minute, backwardly directed spines encircling the anterior part of the first five segments; and occurring ventrally on the remainder of the segments. In lateral view; broadest caudad of the middle, tapering slightly towards the front, abruptly behind; dorsal margin convex, ventral straight or even slightly concave in the middle. Anterior spiracle with four or five papillae. Anal depression as in *rubriventris* but distinctly deeper than in *trilineata*.

Specimens have been examined from Massachusetts, Ohio, District of Columbia, Maryland, and Mississippi. In the Canadian national collection there are several specimens from Vernon, British Columbia, Onah and Aweme, Manitoba. The habitat of *vigilans* appears to be more restricted than that of some of the more common species of the genus. In Mississippi, specimens were taken on the sides of a shady road, in the "flat woods" predominated by short leaf pine in mixture with hardwoods. In Ohio, a puparium was dug from a small sand deposit on a wooded river bank. Adults have not been taken on flowers.

The biology of *vigilans* is linked with that of two species of *Bicyrtes*, *quadrifasciata* from which it has been reared and *ventralis* Say, from whose burrow the female fly has been captured, and with *Bembix spinolae*. All three wasps belong to the sand burrowing Bembicidae. Both species of *Bicyrtes* stock their cells with Hemiptera, while *Bembix spinolae* provisions its nest with Muscoid flies.

Prof. J. B. Parker in 1914, at Washington, D. C., captured a female emerging from the nest of *Bicyrtes ventralis* and another female coming out of a burrow of *Bembix spinolae*.[17]

S. vigilans was also noted in the field during July, 1922 by M. R. Smith who found the flies associated with wasps in a colony of *B.*

[17] Allen, Occ. Pap. Bost. Soc. Nat. Hist., vol. 5, p. 90.

quadrifasciata under observation at Adaton, Mississippi. Several visits were made to this colony during the next few weeks until the extreme dry weather and heavy traffic over the road in which the colony was located obliterated all traces of the wasps. Adults of *vigilans* were abundant about this colony for several weeks. The fly was frequently observed in low zigzag flight over the sand from which it would alight at frequent intervals on small sticks or blades of grass. Intense interest was displayed by females in Bembecids returning to their nests. While the wasps were in flight about their burrows, the flies were frequently seen hovering cautiously about a foot behind them. The presence of the flies seemed to annoy the wasps, which would frequently turn on them and attempt to drive them away, but such attempts were futile, as the flies, no longer pursued, would immediately return. The fly was seen to dart swiftly into the burrow after the Bembicid, and to emerge again, almost immediately, and before the reappearance of the wasp. After depositing its prey, the wasp would emerge, cover up the entrance to its burrow and fly away. In this connection, it may be noted that *quadrifasciata* usually closes its burrow each time that it leaves it, a precaution which serves to repel parasitic flies during its absence but very clearly affords no protection against those with a habit like that of *vigilans*, which enters the burrow during the visits of the wasp. Smith has observed that *quadrifasciata* does not invariably close its burrow when leaving it, as he has on several occasions unearthed several well stocked cells left conspicuously open. Such nests, while especially vulnerable to attack, do not seem to be sought out by *vigilans*. It was observed that the wasp, carrying prey, was the principal cause of excitement and activity on the part of the flies and it is quite likely that in this species, this combination is necessary for the stimulation of the female to larviposition.

A number of the nests of *quadrifasciata* were unearthed and the contents, consisting of the egg of the Bembicid in the midst of Pentatomid and Coreid nymphs, were carefully removed. No evidence of the maggots was found in the field, but in one lot, maggots were unexpectedly encountered a day or two after removing the contents of the cell to the laboratory, and from them the adults of *vigilans* were reared. The bodies of the nymphs were rapidly reduced by the maggots to a putrid mass in which they reveled like Sarcophagid scavengers in decomposing flesh. In the one completed nest of *quadrifasciata* from which this parasite was reared, the maggots did not show up until after the egg of the wasp had hatched. Maggots of *Senotainia* and grub of *Bicyrtes* were both observed feeding on the provisions of the nest on one day, but on the succeeding day, the grub had succumbed, either to direct onslaught by the maggots or the unfavorable conditions produced by them, but at any rate, not to

direct parasitism. At the termination of the feeding period of the maggots, two living nymphs remained still untouched, so it appears in this instance that the competition for food did not furnish the urge for the elimination of the host. So far as could be determined, the somewhat slower growing wasp grub with its more delicately adjusted parasitic life, was overwhelmed in the tumultuous activity of the fly maggots, to whom its death was merely incidental. The maggots, reared during July, developed very rapidly, far outstripping the grubs of *Bicyrtes* reared in the laboratory under the same conditions. Maggots removed with the nest on July 26, pupated on the 30th, indicating a larval period of approximately four days. In Columbus, Ohio, one specimen was reared from a puparium recovered from damp sand near the underground cells of *Bembix spinolae*, indicating that the mature maggots at the termination of the feeding period burrow in the soil that surrounds the nest to pupate. The pupal duration of two individuals was respectively seven and eight days. Possessing the power to complete a life cycle in about two weeks, it is highly probable that generations succeed each other rapidly during the favorable seasons. However, the development of but one generation has been under observation and the seasonal cycle is unknown.

SENOTAINIA LITORALIS Allen

Senotainia litoralis ALLEN, Occ. Papers Bost. Soc. Nat. Hist., vol. 5, p. 90, 1924

Type.—Male, Cat. No. 27232, U.S.N.M., from Moss Point, Mississippi.

This species may be readily separated from *trilineata*, from which it differs in having the frontal rows at their middle separated by a distance less than width of either parafrontal and in having but two weak postsutural dorsocentral bristles. From *vigilans*, it is distinguished by lack of red on the abdomen and usually in the possession of two proclinate orbital bristles. Male specimens differ in having the sides of the fifth sternite roundly angular at the apex and not lobiform, and the hind femur without villosity on the inner proximal surface. The male genitalia are illustrated (pl. 2, fig. 10).

In the one female dissected, the reproductive apparatus (pl. 4, fig. 25) was found to differ from the typical in several respects. Whether these variations are specific or merely individual was not determined. The uterine pouch was balloon-shaped and not chordate; the ovules were filled with ova of all stages of development while at the same time the uterine pouch carried several well developed larvæ. Only two spermathecae were present, and these were united for somewhat more than the basal half. One of the accessory glands was very much reduced in size, the other normal, with the duct less than one-tenth the length of the gland.

This species has been most frequently encountered on the marine beach from Massachusetts to Louisiana. That it also has a limited distribution inland is indicated by the recovery of specimens at Agricultural and Mechanical College, Mississippi, College Station, Texas, and from Indiana and Idaho. In flight, the adults barely clear the sand over which they glide in a swift zigzag course, so closely resembling that of small burrowing Hymenoptera of the beaches that they can be distinguished with certainty only when they alight, as they do at frequent intervals on the surface of the sand. Large numbers of adults, both males and females, were observed on the blossoms of a common *Hydrocotyle* of the upper beach, in full bloom along the Gulf coast in early September. The host relationships are not known.

SENOTAINIA NANA Coquillett

Senotainia nana Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 80, 1897. Type from Las Cruces, N. M.

Microsenotainia nana Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 618, 1915.

This species is very evidently not the same as *Miltogramma nana* Van der Wulp. The latter name has priority, but unless the type which has been lost is located and after reexamination is definitely assigned to this genus, it is deemed inadvisable to propose a new name for Coquillett's species. Townsend proposed a new genus to receive this species on characters which in my opinion are of less than generic rank.

Male.—Front at narrowest 0.29 of head width (measurements of three as follows: 0.27, 0.30, 0.30); inner orbits diverge from base of antennae, slightly towards vertex, moderately towards bucca; front and face merging from black at the vertex to silvery pollinose at bucca; frontal vitta yellow, linear, scarcely wider than lowest ocellus, obliterated at ocellar triangle; about seven very weak bristles in each frontal row, the rows separated by a distance equal to half width of parafrontal; parafrontals strongly flattened towards vertex, lacking bristly hairs; one reclinate and two proclinate orbital bristles; vibrissae strongly approximated, inserted length of second antennal joint above oral margin; facial ridges bare; antennae extending three-fourths distance to vibrissae, red, the third joint scarcely twice as long as second; arista thickened on basal two-fifths, penultimate joint very short; in profile, axis at vibrissae slightly less than at base of antennae, width of bucca less than that of parafacials and equal to one-sixth of eye height; front projects nearly one-half the eye diameter; parafacials bare, palpi yellow. Thorax, including the scutellum, thinly gray pollinose over black, without spots or distinct vittae; usually one and sometimes two postsutural dorsocentral bristles differentiated; one sternopleural; three pairs of marginal scutellar bristles. Abdomen red, excepting

apex of fourth segment which is black, in profile, distinctly arched; without macrochaetae, save for the scarcely differentiated marginal pairs on third and fourth segments; last three segments with a thinly pollinose band confined to basal third of the segment. Genitalia black; in repose, exserted for distance about equal to width of fourth abdominal segment; inner forceps elongate, in profile, curved slightly forward to a strong, sharp point, from behind, are seen to be united into a single laterally compressed process, linear like the back of a knife blade. Wing of usual veination, without costal spine or bristles at base of third vein; proximal half of costa with short, appressed, black hairs. Legs black; pulvilli of fore feet longer than last tarsal joint; middle tibia with one bristle on outer front side near middle; hind tibia with but two bristles on outside near the middle.

Length, 3 to 4 mm.

Type.—Male, Cat. No. 3580, U.S.N.M.

Host relationships.—Unknown.

Redescribed from the type and the paratype, labeled "swept from *Pectis papposa*," Las Cruces, New Mexico (Cockerell), and one male specimen from Los Angeles County, California, all in the National Museum. Female unknown.

SENOTAINIA SETULICOSTA, new species

Male.—Front at narrowest 0.30 of head width (measurements of two as follows: 0.29, 0.31); inner orbits converge moderately from vertex to the base of the antennae, thence divergent in a broad curve to the bucca; front golden pollinose; frontal vitta yellow, linear, scarcely the width of ocellus to above the middle, thence diverging rapidly to vertex; frontal rows of about ten weak bristles, separated at their middle by a distance less than one-half width of parafrontal; one reclinate and two proclinate orbital bristles; parafrontals sparsely beset with black bristly hairs; vibrissae strongly approximated, inserted at distance equal to second antennal joint above front edge of oral margin; facial ridges bare save for one or two bristly hairs above the vibrissae; antennae red, extending about two-thirds distance to vibrissae; third joint equal to second; arista thickened on basal two-fifths, penultimate joint very short; parafacials bare; in profile, the buccal width is much less than that of parafacials, and equals one-sixth to one-tenth the eye height; head length at vibrissae equals that at base of antennae; front projects nearly one-half the eye width; palpi yellow. Abdomen strongly arched in profile, red, excepting apex of fourth segment which is black; broad pollinose bands encircle the basal half of the last three segments; abdomen without macrochaetae save for a weak median marginal pair on the third and fourth segments. Genitalia black;

in repose exserted conspicuously from the tip of the abdomen; inner forceps elongate, united to tip, in profile the posterior edge straight to the apex, viewed from behind broadly triangular. Wings without a costal spine; costa, on its proximal half, with conspicuous, erect, radiating, bristly hairs; third vein without bristles. Legs black; middle tibia with one bristle on the outer front side near the middle; hind tibia with two to five unequal bristles on the outer surface, not extending far beyond the middle.

Length, 4.5 to 5 mm.

Type.—Male. Cat. No. 28151, U.S.N.M., from Pasadena, California, April, 1915.

Host relationship.—Unknown.

Described from the type and one other male from Santa Clara County, California (Baker). Female not known. These specimens in the National Museum, had been labeled "*decisa*," but when compared with the type of that species were found to be incorrectly determined. They are evidently the ones examined by Townsend when "subgenus B" of the genus *Microsenotainia*[18] was proposed for *decisa*. Townsend's *decisa*, however, is without question the same as *rubriventris* Macquart, and differs widely from the two California specimens described above.

SENOTAINIA TRILINEATA (Van der Wulp)

Miltogramma trilineata Van der Wulp, Biol. Cent.-Amer. Dipt., vol. 2, p. 89, 1890. Type locality, Presidio, Mex.

Arrenopus americanus Brauer and Bergenstamm, Denkschr. Akad. Wien., vol. 58, p. 361, 1891. Type locality, Georgia.

Miltogramma argentifrons Townsend, Trans. Amer. Ent. Soc., vol. 18, p. 357, 1891.

Miltogramma cinerascens Townsend, Trans. Amer. Ent. Soc., vol. 18, p. 358, 1891.

Senotainia trilineata Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 81, 1897.—Smith, Ins. of New Jersey, p. 778, 1909.—Johnson, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 72, 1913.—Walton, Proc. U. S. Nat. Mus., vol. 48, p. 182, 1914.—Aldrich, An. Ent. Soc. of Amer., vol. 8, p. 82, 1915.—Gibson, Ent. Soc. Ont. Rept. 1919, p. 127.—Reinhard, Ent. News, vol. 30, p. 284, 1919.—Cole and Lovett, Proc. Cal. Acad. Sci., vol. 11, p. 301, 1921.—Brimley, Ent. News, vol. 33, p. 25, 1922.—Curran, Can. Ent., vol. 55, p. 174, 1923.

Eusclenomyia peruviensis Townsend, Proc. U. S. Nat. Mus., vol. 43, p. 364, 1912. Type from Peru.

Male.—Front at narrowest 0.24 of the head width (measurements of five as follows: 0.23, 0.24, 0.24, 0.24, 0.25); frontal vitta largely gray to golden pollinose; frontal rows not closely bordering the vitta, separated at their middle by distance greater than width of either parafrontal; small, black, bristly hairs on parafrontals below orbitals,

[18] Proc. U. S. Nat. Mus., vol. 49, p. 619.

which extend in an irregular row on parafacials almost to bucca; antennae black, excepting apex of second joint, which is red; in profile, buccal width exceeds that of parafacial and equals one-fourth eye height; head length at vibrissae equals that at base of antennae; palpi yellow, usually with black tips. Thorax with three distinct postsutural dorsocentrals and two sternopleural bristles. Abdomen densely gray pollinose over black, without red spots on the sides, the narrow margins of the segments yellowish brown; with three more or less vague black spots on each of the last three segments; the second segment bears a strong median marginal pair of bristles, the third and fourth each with marginal rows. Genital segments and forceps subshining black; inner forceps (pl. 2, fig. 7) scarcely twice as long as broad, tapering uniformly to sharp, stout points curved sharply forward at tips, broadly divergent when viewed from behind; outer forceps shorter than inner pair, curved inward to rounded spoon-like tips. Wings without costal spine; with one to two small bristles at base of third vein.

Female.—Width of front at narrowest 0.24 of head width (measurements of five as follows: 0.23, 0.24, 0.24, 0.24, 0.26); vertex, front and face more deeply golden pollinose than in the male; in profile, buccal width equals one-fifth eye height. Thorax and abdomen golden pollinose. Otherwise like the male excepting the usual differences in genitalia and size of pulvilli.

Length 3.0 to 7.0 mm.

This species is one of the most common Muscoid flies of North America. Redescribed from a long series of both sexes from all parts of the United States, one male from San Carlos, Costa Rica (Schild and Burgdorf), and one female from Chinandega, Nicaragua (Baker). Townsend's eight specimens from Peru (*Euselenomyia peruviensis*), which are before me, differ slightly from the typical North American specimens in having the parafacials more bristly, and the first abdominal segment of the males and some of the females with a pair of distinct median marginal bristles. In much of the western material examined, which includes specimens from Colorado, Idaho, Nevada, New Mexico, Washington, and California, the three black spots on the intermediate segments of the abdomen are sharply defined from the surrounding white pollen, and the frontal bristles are noticeably weaker than in typical eastern specimens. The male genitalia of these Peruvian and western forms are apparently identical with that of the form from the eastern United States. After a careful study of available material I am inclined to retain all under *trilineata*.

Of four specimens of *trilineata* determined by me and forwarded to Major Austen, he finds that one is *trilineata* by comparison with the type. The others, however, appear to him to represent a different species, with which opinion I can not concur. The type of

Arrenopus americanus was loaned from the Vienna Museum for examination and the synonymy of Coquillett verified. Townsend's types for *argentifrons* and *cinctacens* have been loaned by the University of Kansas Museum, and the synonymy of Coquillett and of Aldrich verified.

In the four specimens in which the female reproductive organs were dissected there was agreement in the following characters (pl. 4, fig. 20): Spermatheca, three, their ducts elongate, without inflations, two of the ducts united on the distal half; accessory glands of equal size, somewhat less than ten times as long as their ducts; uterine pouch distinctly chordate; ovaries emptied, even before maggots in uterus had reached their full development.

The only difference in the morphology of the uterine maggot noted between this species and others of the genus studied, is found in the buccopharyngeal apparatus (pl. 5, fig. 31). In this, the median hook is suddenly constricted just beyond the base, expanding again near the tip, thence tapering to a stout point, the axis of which is almost perpendicular to the axis of the buccopharyngeal apparatus; lateral hooks with broad, nearly parallel sides to near tips, thence tapering abruptly to minute recurved points having a deep U-shaped invagination on ventral margin.

The puparium very closely resembles that of *vigilans* and *rubriventris*, from which, however, it differs in minor characters. It is chestnut brown in color, with minute spines encircling the anterior part of the thoracic segments; each segment with fine lateral striations, the anal segment without well defined spines above the depression. In lateral view, it is deepest at the middle, tapering slightly in both directions; the dorsal margin is straight, the ventral margin broadly convex. Anterior spiracle with six to seven papillae; posterior spiracles separated by a distance slightly greater than their width, and located slightly above the horizontal bisecting plane. Anal depression shallow.

The known range of *trilineata* is greater than that of any other species of the genus. Northward it has been recorded as far as New Hampshire, Ontario, Illinois, Minnesota, Canadian Northwest Territory, and British Columbia. Curran reports it from Fort Simpson, near 62° latitude, far north of the known distribution of any other species of this group, and not far from the Arctic Circle. Southward from this limit it has been reported from numerous localities representing nearly every state of the United States, and from Mexico, Nicaragua, and Costa Rica. Townsend has recovered what is in all probability the same species from Peru. It is not known outside of the American continents.

Notwithstanding its abundance and wide distribution, but very little has been published on the biology of this species. The writer

has had this form under observation at frequent intervals during the past three seasons, and has been able to gather some information on its life cycle and ecology.

Adults are generally present throughout the warmer months. In Ohio, Mississippi, and the District of Columbia, where this species has been under observation, it was found to be more widely distributed over the terrain than any other species of *Senotainia*. It occurs, however, most commonly over barren sandy soil such as is found along river banks, and on denuded ground, such places being sought out also by the fossorial Hymenoptera with which it is associated. The adults are not often found on rank vegetation except when attracted by the blossoms of certain plants, but they visit in conspicuous numbers, a considerable number of flowers including *Erigeron*, *Anthemis cotula*, and *Euphorbia corollata*. In the southern states, in early fall, they are attracted in large numbers to cowpeas, where they secure some food substance at the tip of the pod-bearing stalks. They frequently appear on *Erigeron* and cowpeas, even when these occur in dense stands on low rich ground at considerable distances from barren soil.

Few published records can be found concerning the host relationships of this species. There is one record of its issuance from a nest of *Sphecius speciosus*.[19] It is also reported as having been reared from the common army worm,[20] but this is so definitely at variance with the usual activity of this species and its allies as to be decidedly questionable. In a recent interesting article on the "ovipositional" habit of *trilineata*,[21] Curran mentions other species of fossorial Hymenoptera, none of which were linked with this species in a wholly convincing manner. The writer has reared several specimens from the nests of *Bicyrtes quadrifasciata*. Prof. J. B. Parker secured several specimens from a nest of *Bicyrtes ventralis*. The three wasps from which it has been reared are Bembicidae which burrow in the sand. One stocks its nest with flies, largely Muscoidea, the other two with Hemipterous nymphs. Bembicid wasps, according to the writer's observations, are never as abundant as *trilineata* adults; therefore it seems probable that the latter will be found by further observation to issue from the nests of several other common species of Hymenoptera.

Professor Parker has submitted the following information regarding the rearing of *trilineata* from *Bicyrtes ventralis* at Washington, D. C. On June 13, 1914, the wasp "was discovered storing a nest with nymphs of a Hemipterous insect. It was marked and was opened on June 20, 1914. It contained the remains of seven bugs and ten fly puparia. No trace of the larval wasp was found. The

[19] Coquillett, U. S. Bur. Ent, Tech. Ser., No. 7, p. 20, 1897.
[20] Forbes, Psyche, vol. 6, p. 467, 1893.
[21] Can. Ent., vol. 55, p. 174, 1923.

puparia were four inches below the surface of the ground. The soil was a sandy loam. The puparia were put in a breeding cell. On July 4, 1914, all flies had emerged."

The writer secured the following information in rearing from *Bicyrtes quadrifasciata*. A female was noted intently watching the wasp building its burrow and was captured and identified. A single nest from a lot of several collected in this colony was found to be infested with six maggots, all of which proved to be *trilineata*. The development of the maggots in this nest proved to be almost identical with that of the larvae of *S. vigilans*, previously discussed. The maggots remained undiscovered until after the wasp egg had hatched, but the grub of the wasp failed to develop since it was soon overwhelmed by the rapidly growing Dipterous larvae. In this case, all the stores of the wasp were consumed, the maggots spending the greater part of their developmental period as Sarcophagidlike scavengers in the midst of the decomposing bodies of the bug nymphs. The larval period from the time the nest was collected to the formation of the puparium was four to five days. Since the nest was not collected at actual larviposition time, the total larval period may have been a day or two longer. Puparia were formed in damp sand beneath the débris of the nest. The pupal period ranged from eight to eleven days, four of the six that were reared emerging on the ninth day.

Regarding the establishment of parasite on host, the writer has made no direct observations. Curran states that *S. trilineata* females poise over the entrance of the burrow and drop eggs directly into it as the wasp drags her prey down into it. The white objects seem dropping into the burrow, which he plainly states were not recovered for closer examination, were in all probability active, naked larvae, such as are readily demonstrated in the uterus of this and all nearly related species. The writer has dissected several gravid females of *S. trilineata*, in all of which the uterus was filled with large white maggots not exceeding 75 in number.

Several workers have noted the presence of annoying and persistent Dipterous parasites in connection with their studies of the bionomics of various fossorial Hymenoptera. Most of them have reared these parasites in sufficient numbers to be impressed with the idea that they constitute a heavy drain on the economy of the wasps. Several have noted that the wasps frequently turn on their wary pursuers, and attempt to drive them away. None, however, seem ever to have observed the wasps catching these elusive little flies. But observations made by the writer indicate that one species of wasp not only catches these flies but uses them to provision its nest. Several nests of *Bembix spinolae* were dug out at Columbus, Ohio, in the summer of 1921, which were found to contain the dismembered chitin-

ous remains of many flies, as they had been left by the feeding stages. These were taken to the laboratory and carefully examined, and found to contain. among others, the dismembered parts of what was unquestionably *S. trilineata*. Heads and male genitalia, both of which are sufficient for diagnostic purposes, were isolated from the general débris. This observation indicates a unique relationship between these two species. The wasp, which provides its nest with flies of several species, apparently does not hesitate to use the bodies of its *Senotainia* parasites when they can be captured, while the fly lurks about its enemy and host, infesting its nest with maggots, whenever opportunity offers. We have here then, an interesting case of wasp predaceous on fly, and fly in turn parasitic on wasp. But stranger still, *Senotainia* maggots in the nests of this wasp must be accustomed to subsisting in part on the bodies of the adults of their own species, when such are provided by the host. In fact, it is not improbable, as our discussion at another place of experiments performed with this species will show, for this wasp by capturing and carrying into its nest the body of a mature female *Senotainia*, to unwittingly infest its nest with the parasite.

In connection with the work on *S. trilineata*, it was discovered that larvae carefully pressed from the body of gravid females were capable of readily establishing themselves under artificial conditions. It appears worth while to dwell briefly on the information secured through them, first because our knowledge of the habits of the immature stages of this group have not been thoroughly worked out and secondly because it serves to further establish the Sarcophagid affinities of the group.

In one experiment, several active maggots squeezed from a gravid female were placed on nymphs of *Leptoglossus*, artificially paralyzed by crushing the head, to simulate the condition of the normal food. The maggots started to feed at once, through holes torn in the exoskeleton, at joints not heavily reinforced, such as the leg sockets. They frequently buried their body up to the anal plate in the feeding punctures. The maggots developed normally, so far as could be discovered, becoming in their later instars scavengers on the decaying bodies of the bugs. Two of the lot formed puparia, which, however, failed to emerge.

In another instance, the body of a female which had been allowed to lie in the cage for a day following death, was found to contain several healthy maggots which had consumed the softer tissues within the body of their mother. These were placed on the body of a freshly killed adult *Leptoglossus* and started immediately to wander over the body in search of food, seeking the softer places in the integument where they proceeded to make punctures by raking backward and forward with the mouthhooks. The morning after placing on pre-

pared food, the lot was examined. Four were found with the anterior end inside the body of the bug, entrance having been secured through rents torn between the sclerites, the posterior third of the maggots were exposed.

In another experiment, maggots squeezed from the female were placed on *Leptoglossus* nymphs artificially paralyzed, two maggots to each of five nymphs. All of the maggots established themselves but one. The nymphs were carefully examined the following day, and showed no external evidence of the parasites, in this respect differing from the two previous experiments. One was dissected and both maggots, early in the second instar, were found wholly within the body of the host, which was dead, but whose tissues had as yet shown no signs of decay. On the following day, or when the maggots were two days old, another nymph was dissected, and found to contain both maggots, in the second instar, wholly concealed within the body, apparently in excellent condition and feeding on the body contents, now brown, semifluid, and in a moderately advanced state of decay. On the following day, all the remaining nymphs were dissected and the maggots were found to be dead, quite likely because of the extensive desiccation of the food material.

These experiments with the maggots of *S. trilineata* are too limited to serve as a satisfactory basis for generalization, but certain points are indicated which it may be allowable to express. First, it is evident that this species is not a primary parasite of the wasps with which it associates, nor yet is it a commensal in the ordinarily accepted sense of that term. No term seems to exactly describe the relations of these two forms. The maggot is at first a true parasite on the living insects captured by the wasp, in the later stages becoming a scavenger on their putrifying bodies, and incidentally it may assume the rôle of predator on the young of the wasp for which the paralyzed insects have been provided.

SENOTAINIA RUFIVENTRIS (Coquillett)

Hilarella rufiventris Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 129 1897. Type from Holly Springs, Mississippi, located in National Museum.
Eusenotainia rufiventris Townsend, Proc. Biol. Soc. Wash., vol. 26, p. 22, 1915.

This species was without question incorrectly placed by Coquillett in the genus *Hilarella*. Townsend recognized this and proposed a new genus without describing it. The species possesses all the typical characters of the *rubriventris* series of *Senotainia* from which it differs slightly in possessing somewhat longer face and antennae. In the writer's opinion these are not variations of generic significance, and the close relationship with the *rubriventris* series can best be recognized by retaining it in the same genus.

Male.—Front at narrowest 0.37 of the head width (measurements of three 0.36, 0.36, 0.38); orbits most nearly approximated at base of antennae, diverging slightly above, widely below, with a slight emargination at the level of vibrissae; front and face silvery pollinose, frequently grayish or golden pollinose at the vertex; frontal vitta triangular, yellowish, submerged posteriorly beneath dense pollen; frontal rows with about nine bristles, separated at middle by distance almost equal width of parafrontal; one reclinate and two proclinate orbital bristles; parafrontals destitute of bristly hairs; vibrissae strongly approximated, nearly the length of second antennal joint above the front edge of oral margin; facial ridges with two or three bristly hairs on their lowest fourth; antennae red, extending seven-eighths distance to vibrissae, third joint five times as long as the second; arista thickened nearly to tip, penultimate joint slightly longer than broad; parafacials bare; in profile, width of bucca equals parafacials and is one-tenth eye height, head length at vibrissae is distinctly less than at base of antennae, front projects more than one-third eye width; palpi yellow. Thorax gray pollinose over black, without distinct vittae; two postsutural dorsocentral bristles are distinguishable; two sternopleurals present; the scutellum bears three marginal pairs of which the apicals are the strongest; weak preapicals present. Abdomen largely red, fourth segment black, the third partly so; last three segments with thinly pollinose bands on their basal half; first two segments without bristles, third and fourth with marginal rows of about ten weak ones. Genitalia black, in repose, protruding from abdomen for distance equal to one-half the length of fourth abdominal segment. Wings without costal spine; third vein with a single small bristle at its base. Legs black; middle tibia with a single bristle on outer front side near middle; hind tibia on outer surface with several weak bristles on proximal three-fifths.

Female.—Front at narrowest 0.29 of the head width (measurements of three 0.28, 0.29, 0.30); frontal vitta narrower than in the male; frontal rows at their middle separated by a distance equal to two-thirds width of parafrontal; distance of vibrissae above the oral margin fully equals the second antennal joint; vibrissae more strongly approximated than in male; third antennal joint two and one-half to three times the second. Otherwise, except for the usual sexual differences of the pulvilli and genitalia, like the male.

Length 3.0 to 6.0 mm.

Type.—Male, Cat. No. 3755, U.S.N.M.

Host relationships.—Unknown.

Redescribed from the type, and two males and one female of the type series from Holly Springs, Mississippi (F. W. Mally); one male, Lafayette, Indiana (J. M. Aldrich); one female, Owen's Lake, California (J. M. Aldrich); all in the collection of the National

Museum: one female, Phoenix, Arizona (A. K. Fisher), in the collection of J. R. Malloch: and one female, Holly Springs, Mississippi (H. W. A.), in my collection. The specimen from Owen's Lake has an arista with a rather long penultimate joint but agrees in other respects with the typical, and is probably the same species.

Genus OESTROHILARELLA Townsend

Oestrohilarella Townsend, Insecut. Insc. Menst., vol. 6, p. 162, 1918. Genotype, *Hilarella aristalis* Coquillett from southern Illinois.

Readily distinguishable from *Hilarella, Phrosinella,* and *Eumacronychia* by the absence of any definite angle between the facial and buccal margin, when viewed from the side, and the presence of a globose or subglobose abdomen upon which the macrochaetae are scarcely differentiated. The genus also differs from *Hilarella* in having the last section of the fifth vein much less than half as long as the preceding section, and in the absence of a costal spine; from *Phrosinella* in having the lunule minute and largely concealed, the frontal rows not extending beyond the base of the antennae and not suddenly divergent below, the parafacials not suddenly constricted near the lower inner corner of the eye; from *Eumacronychia* in not having the pollen of the abdominal segments limited to dense, even, basal bands. Other distinguishing characters are as follows; a single frontal row on either side of the vitta; orbital bristles present in both sexes; antennae extending much more than half the distance to the vibrissae, which are inserted just above the oral margin; proboscis much shorter than head height; small bristly hairs on less than the lowest half of the facial ridges; in profile, head length at vibrissae much less than at base of antennae; no pale hairs on bucca or back of head about the oral cavity; two sternopleural bristles present; wings with but a few bristles at base of third vein.

A single North American species is referable to this genus.

OESTROHILARELLA ARISTALIS (Coquillett)

Hilarella aristalis Coquillett, U. S. Bur. Ent., Tech. Ser., no. 7, p. 129, 1897.

The front of the male is distiently wider than that of the female (measurements of the ratio of the front at narrowest to head width, for males an average of 0.365 for two measuring 0.36 and 0.37, respectively; for females an average of 0.308 for six measuring 0.29, 0.29, 0.30, 0.31, 0.33, and 0.33, respectively); one reclinate and two proclinate orbital bristles; frontal vitta black and at level of lowest orbital slightly wider than either parafrontal; third antennal joint black, three times as long as the second; arista thickened on basal three-fourths; parafacials bare on lower half. Thorax gray pollinose with four distinct black vittae; three postsutural dorsocen-

tral bristles present; scutellum with three nearly equal pairs of marginals. Abdomen densely gray pollinose, the intermediate segments when viewed from the rear each with three large, vaguely defined, triangular black spots. In the female, sclerites which appear to be the fourth, fifth, and sixth sternites but which are very likely part of the genitalia, together with the lower valve of the genitalia, cause a conspicuous bulge in the lower, posterior part of the abdomen. Wings hyaline; apical cell closed or narrowly open at margin of wing; hind cross-vein not parallel to section of fourth vein beyond the bend. Legs black, rather short and stout; middle tibia with one bristle on outer front side near middle.

Length 4.0 to 5.0 mm.

Type.—Male, Cat. No. 3634, U.S.N.M.

Host relationship. Unknown.

Range.—New York, Virginia, Indiana, Illinois, Colorado, Arizona, California, British Columbia.

The following material has been examined: The type, which is a male from southern Illinois (Robertson), and a female from Santa Clara county, California (Baker), of the type series; two from Colorado (Coquillett), two from Lafayette, Ind. (J. M. Aldrich); and other specimens from Kaslo, British Columbia (R. P. Currie); Oswego, New York; Tuscon, Arizona (J. M. Aldrich); all in the collection of the National Museum. Two females from Falls Church, Virginia in the collection of Mr. Nathan Banks.

Genus OPSIDIA Coquillett

Opsidia COQUILLETT, Journ. New York Ent. Soc., vol. 3, p. 102, 1895; Proc. U. S. Nat. Mus., vol. 37, p. 580, 1910. Genotype, *O. gonioides* Coquillett, Atlantic City, N. J.—ADAMS, in Williston's North American Diptera, p. 376, fig. 151, No. 90, 1908.—TOWNSEND, Smithsonian Misc. Colls., vol. 41, p. 64, 1908.

In Coquillett's description of the genus, only a single male was available, and some of the characters given can scarcely be considered more than specific. The outstanding characters of the genus based on the genotype, and a new species, *O. metopioides,* are as follows:

Front with a single frontal row of bristles on either side of the vitta, which extend downward to slightly below base of antennae; proclinate ocellars present; orbital bristles in both sexes. The facial depression deep and narrow with parallel sides, is the most distinctive character of the genus. Facial ridges with bristly hairs not extending above the lowest fourth; vibrissae differentiated, and inserted far above front edge of oral margin; antennae extending nearly to vibrissae; arista with penultimate joint less than twice as long as wide; in profile, head length at vibrissae much less than at base of antennae; bucca and back of head black setulose, without pale hairs about the oral cavity; proboscis slender, at most slightly

shorter than head height; palpi well developed. Thorax with two sternopleural bristles. Genitalia of male (pl. 1, fig. 5), small, and in repose, scarcely protruding from tip of abdomen; of female, retracted and non-piercing. Wings with apical cell open; last section of fifth vein distinctly less than half as long as preceding section; costal spine wanting; middle tibia with one macrochaeta on outer front side near the middle; hind tibia on outside with row of uneven bristles extending from base to apex.

KEY TO NORTH AMERICAN SPECIES OF OPSIDIA

1. Front, at base of antennae, twice as wide as either eye; arista thickened nearly to tip ..... **gonioides** Coquillett.
   Front, at base of antennae, as wide as either eye; arista thickened on less than the basal half ..... **metopioides**, new species.

OPSIDIA GONIOIDES Coquillett

Opsidia gonioides COQUILLETT, Journ. New York Ent. Soc., vol. 3, p. 102' 1895; U. S. Bur. Ent., Tech. Ser., no. 7, p. 128, 1897.—SMITH, Ins. of New Jersey, p. 782, 1909.

The distinctive characters of this species are as follows: Female closely resembles the male. Inner orbits parallel from vertex to bucca; front approximately twice the width of either eye and of equal width in both sexes; ratio of front to head width in males averages 0.496 (in five measuring 0.49, 0.49, 0.50, 0.50, 0.50), in females averages 0.493 (in four measuring 0.48, 0.48, 0.50 and 0.51); the frontal vitta is red, densely overlaid with golden pollen; much narrower at base of antennae, expanding abruptly at middle to width greater than either parafrontal; ocellar bristles directed laterally; one reclinate and two proclinate orbital bristles present, parafrontals densely black setulose, the bristly hairs continuous downward over the parafacials, to tip of antennae; vibrissae inserted more than length of second antennal joint above front edge of oral margin, but a collapsible membranous area at this point makes this character widely variable; second joint of antennae red; third joint black; arista thickened on basal four-fifths; parafacials with a row of small macrochaetae bordering facial ridges; palpi yellow; in profile, buccal width is subequal to that of parafacials and equal to one-fifth eye height, front projects a distance nearly equal to horizontal eye diameter. Thorax densely pollinose, with two somewhat obscure, divergent median vittae, and a pair of lateral convergent vittae most clearly defined caudad of transverse suture; three postsutural dorsocentral macrochaetae, of which the first is scarcely differentiated from the surrounding bristly hairs; scutellum with three pairs of strong, nearly equal macrochaetae. Abdomen densely gray pollinose, with dark reflections, but without definite spots or polished apical bands; second segment, and usually the first, with a median marginal pair

of bristles; third and fourth segments with marginal rows; macrochaetae on first three segments short, on anal segment slightly larger. Wings hyaline; third vein with four or five bristles extending less than half way from base to small cross-vein. Legs black; the basitarsus of front leg in male slightly longer than last four joints, in female distinctly shorter; pulvilli much shorter than last tarsal joint and of equal size in both sexes.

Range.—Massachusetts, New Jersey, Maryland, Mississippi, Ohio, Indiana, Wisconsin, Iowa, Nebraska, New Mexico.

Host relationships.—Unknown.

The following material has been examined. The type, a male from Atlantic City, New Jersey, in the collection of Dr. C. W. Johnson; males and females from the following localities: two, Horseneck Beach, Massachusetts, (Coquillett); Iowa; Chesapeake Beach, Maryland (R. C. Shannon); Las Cruces, New Mexico, (C. H. T. Townsend); Lincoln, Nebraska, (O. C. Bradbury); twenty-nine, Lafayette, Ind. including two labeled "from *Asclepias incarnata*" and one, "flowers of *Solidago*" (J. M. Aldrich); two, Crawfordsville, Indiana; all in the collection of the U. S. National Museum, including the Aldrich collection. Six specimens from Sandusky, Ohio, Cedar Point, in the collection of Prof. J. S. Hine. Specimens from Milwaukee, Wisconsin. (S. Graenicher); Chesapeake Beach, Maryland; Massachusetts; Lafayette, Indiana; in the collection of the Museum of Comparative Zoology at Cambridge, Massachusetts, and in that of Nathan Banks. Two from Tupelo, Miss. (H. W. Allen); two, West Springfield, Massachusetts, (H. E. Smith); in the collection of the writer.

Very little is known of the biology of this species. Dr. J. M. Aldrich's observations indicate that the adults are attracted to flowers. The reproductive organs of two dried specimens have been studied. One was found to contain 61 and the other 79 eggs, which is a rather large number for *Miltogramminine* flies. The eggs (pl. 4, fig. 26) were elongate, all at nearly the same stage of development, and in one of the specimens contained partly developed maggots in which the buccopharyngeal apparatus was faintly visible, the thin, delicately reticulated chorion was persistent over the anterior end of the maggot, but was rolled away from the posterior end of the body. Owing to the condition of the specimens dissected, it was impossible to determine the nature of the internal reproductive organs, but from the presence of partially developed maggots already partly freed from the chorion, it is probable that the species deposits active maggots.

OPSIDIA METOPIOIDES, new species

Front at narrowest point, in single specimen measured, 0.35 of head width; inner orbits most nearly approximated at base of antennae, diverging moderately and equally to vertex and bucca; frontal vitta black, narrowest at base of antennae, sides diverging to vertex, vitta at level of lowest ocellus, slightly wider than either parafrontal; parafrontals gray pollinose; about thirteen bristles in the single frontal row, which extends downward as far as base of second antennal joint; one reclinate and two proclinate orbital bristles, which are much stronger than bristles in frontal rows; sparse bristly hairs on front outside of macrochaetae; vibrissae inserted one and one-half times length of second antennal joint above front edge of oral margin; facial ridges nearly parallel; bearing two bristly hairs just above the vibrissae; antennae extend five-sixths the distance to vibrissae; second joint red; third joint black, four times as long as second; arista thickened on basal two-fifths; in profile, width of bucca equals that of parafacials, and is one-sixth eye height, front protrudes one-third the eye diameter; parafacials with sparse microscopic hairs. Bucca with very fine, black hairs; palpi yellow. Thorax golden pollinose over black, with three somewhat obscure black vittae, perceptible to scutellum; three postsutural dorsocentral bristles of which the first is scarcely larger than the surrounding bristly hairs; scutellum uniformly pollinose, with three pairs of marginal bristles; prescutellars scarcely differentiated. Abdomen black, the bases of the last three broadly, and the first segment entirely, pollinose; first and second segments each with a pair of median marginal bristles; third and fourth with median marginal rows of ten to fourteen bristles. Genitalia black. Wings hyaline; penultimate section of fourth vein equaling three-fifths the preceding section; hind cross-vein nearly parallel to section of fourth vein beyond the bend; third vein with row of small bristles extending nearly to small cross-vein. Legs black; pulvilli half as long as last tarsal joint.

Length, 7 mm.

Type.—Male, Cat. No. 28152, U.S.N.M.

Described from one male, Porto Bello, Panama, April 22, 1912. (A. Busck.)

Genus OPSIDIOPSIS Townsend

Opsidiopsis Townsend, Proc. U. S. Nat. Mus., vol. 56, p. 544, 1919. Genotype, *oblata* Townsend, from Wild Horse Canyon, Animas Mountains, New Mexico.

This genus was erected by Townsend to receive a single species having the habitus of *Opsidia* from which it is readily distinguished by the row of bristly hairs on the first vein and the last section of the fifth vein being distinctly more than half as long as the preceding section. The presence of the bristly first vein is unique, serving to

distinguish the genus from all other known North American Miltogramminae. Other outstanding characters are as follows; the presence of a single frontal row, the macrochaetae of which descend below the base of the antennae; vibrissae inserted near oral margin; antennae extending nearly to vibrissae; parafacials with a row of macrochaetae near the facial ridges which increase in size, downward. Thorax with two sternopleural bristles. Wings with first apical cell open and ending far before extreme wing tip; fourth vein with the usual strong fold at the bend. Middle tibia on outer front side near middle with a single macrochaeta.

OPSIDIOPSIS OBLATA Townsend

Opsidiopsis oblata Townsend, Proc. U. S. Nat. Mus., vol. 56, p. 544, 1919.
Chaetoplagia modesta Reinhard, Ann. Ent. Soc. Amer., vol. 14, p. 234, figs. 9, 10, 1921.

The synonomy given above was pointed out to me by Dr. J. M. Aldrich who had previously compared the types. In this species the third antennal joint and the palpi are black; the frontal vitta at its middle is fully three times as wide as either parafrontal; the thorax is marked with four black vittae; three postsutural dorsocentral bristles are present; the scutellum bears three pairs of long marginals; the last three abdominal segments are white pollinose on the broad bases, with polished black apices; the first abdominal segment is without median marginal bristles, the second and the third each bears a marginal pair, and the fourth a marginal row; the costal spine of the wing is minute.

Type.—Female, Cat. No. 22090, U.S.N.M.

Host relationships.—Unknown.

Range.—Utah, New Mexico, Texas.

The following material has been examined. The type, a female from Wild Horse Canyon, Animas Mountains, New Mexico, 5,000 feet (C. H. T. Townsend), in the National Museum; one female from College Station, Texas, type for (*Chaetoplagia modesta* Reinhard (H. J. Reinhard); and one other specimen from North Bear Run, Utah (A. Wetmore). Townsend reports collecting the adult on tender mesquite foliage.

Genus METOPIA Meigen

Metopia Meigen, Illig. Mag., vol. 2, p. 280, 1803. Genotype, *Musca leucocephala* Rossi from Europe.—Schiner, Fauna Austr., vol. 1, p. 488, 1862.—Brauer and Bergenstamm, Zweifl. d. Kaiserl. Mus., vol. 56, p. 114, 1889; vol. 60, p. 168, 1893.—Van der Wulp, Biol. Cent.-Amer., Dipt., vol. 2, p. 114, 1890.—Coquillett, U. S. Bur. Ent., Tech., Ser., No. 7, p. 127, 1897; Proc. U. S. Nat. Mus., vol. 37, p. 569, 1910.—Adams, in Williston's Manual of N. A. Dipt., p. 376, fig. 151, no. 88, 1908.—Townsend, Smithson. Misc. Coll., vol. 51, p. 56, 1908; An. Ent. Soc. Amer., vol. 4, pp. 130, 140, 1911.

Ophelia Robineau-Desvoidy, Myod., p. 120, 1830. Preoccupied 1817 in Vermes. The genotype according to Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 510, equals *campestris* in *Metopia*.—Townsend, Ins. Ins. Menst., vol. 4, p. 8 *gracilis* Robineau-Desvoidy designated as type.

Araba Robineau-Desvoidy, Myod., p. 127, 1830; Dipt. des Environs de Paris, vol. 2, p. 88, 1863. This name modified by the author to *Arabella*, for sake of euphony. Genotype designated by Desvoidy in 1863, *Tachnia argyrocephala* Meigen, which equals *leucocephala* Rossi, the genotype of *Metopia*.

Anicia Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 99, 1863. Genotype, *sabulosa* which according to Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 510, belongs in the genus *Metopia*.

Arabella Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 88, 1863. Genotype, *Tachina argyrocephala* Meigen considered by some European workers as synonymous with *leucocephala* and by others as a very nearly related species in the genus *Metopia*.

Argyrella Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 87, 1863. Genotype, *dissimilis* which according to Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 512, equals *leucocephala* in *Metopia*.

Argyria Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 82, 1863. Preoccuppied by Hubner in Lepidoptera, 1816. Genotype *leucocephala* of Rossi which, however, is type of *Metopia*.

Parametopia Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 619, 1914. Genotype, *morrisoni* which equals *lateralis* Macquart and is congeneric with *leucocephala*. In this synonomy, I have followed Bezzi and Stein, adding to their list Townsend's *Parametopia* after comparison of genotypes.

The known North American species of the genus *Metopia* possess the following characters. Width of front is with some species greater in the male, in others in the female. There is a single frontal row on each side of the vitta, extending as far as, or slightly below, base of second antennal joint, suddenly divergent below; lunule conspicuous, nearly half as long as wide; small proclinate ocellar bristles present; orbital bristles in both sexes, four on each side, of which the lowest is proclinate, the uppermost reclinate, and the intermediate two decussate; facial ridges divergent, with small bristly hairs not extending above the lowest fourth; vibrissae nearly or quite level with oral margin; antennae extending nearly to vibrissae; penultimate joint of arista at most slightly longer than broad; parafacials with a row of strong macrochaetae bordering the facial ridges, becoming progressively larger as they approach the vibrissae; in profile, head length at vibrissae much less than at base of antennae, epistoma not visible, head with a pronounced conical contour; bucca and back of head with black bristly hairs, no pale hairs on the sides and back of oral cavity; facets of eye at extreme front but slightly larger than those at side of head; proboscis rarely one-half head height, very short and stout, with large fleshy labella; palpi moderate to very small in size or entirely lacking. Thorax with two sternopleural bristles and three strong postsutural dorsocentrals; scutellum with three pairs of strong marginal bristles. Pollen of abdomen usually interrupted by one to

three irregular spots on each segment but never occurring in even, sharply defined basal bands; strong marginal abdominal bristles present, no discals. Genitalia of male (pl. 1, figs. 1, 2) small, in repose retracted within abdomen so as to be scarcely visible in profile view; females with the usual retracted larvipositors, without piercing parts. Wings with the apical cell open; fourth vein with a distinct fold at the bend; last section of fifth vein not more than half length of preceding section; costal spine wanting; only third vein bristly, and this with row of small bristles usually extending at least half way to small cross vein. Pulvilli of about equal size in both sexes and usually less than half as long as last tarsal joint; fore tarsus of male frequently ornamented with several long erect bristly hairs (pl. 3, fig. 19); middle tibia with not more than one macrochaeta on outer front side near middle.

Townsend [22] dissected one species of the genus and found that it possesses the typical double-pouched uterus of the Miltogramminae. Thompson [23] who has studied the first instar maggots of *leucocephala*, *lateralis*, and *campestris* found that all possess a buccopharyngeal apparatus with a strong median stylet which articulates on the very slender dorsal accessory piece, two weak lateral hooks and the basal piece, the latter fused without articulation to the intermediate piece. The cuticula of each segment is armed anteriorly by a band of minute, flattened, transparent scales, and posteriorly by a wider band of longitudinal corrugations.

The genus is represented in Europe, North and South America. In North America it does not have so extensive a range as *Senotainia*, not being known north of Grand Lake, Newfoundland, southern Quebec and Kaslo, British Columbia, or south of Cuba and Guerrero, Mexico.

The adults frequent denuded soil, low herbaceous vegetation, and in the case of some species, the foliage of shrubby plants in open forests. They are not known to be attracted to flowers but some species are drawn, in large numbers, to foliage smeared with the honeydew of Hemipterous insects. These flies are biologically superimposed upon fossorial Hymenoptera which nest in the ground, and have been reared from or found associated with species of several families including the Halictidae, Sphecidae, Bembicidae, and Cerceridae.

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[22] An. Ent. Soc. Amer., vol. 4, p. 130, 1911.

[23] Paris Edition du Bull. Biol. de la France et de la Belgique, Recherches sur les Diptères Parasites, pp. 110–114, 1921.

KEY TO NORTH AMERICAN SPECIES OF METOPIA.

1. Frontal vitta at level of lowest orbitals, wider than either parafrontal ..... 4.
   Frontal vitta, at level of lowest orbitals, narrower than parafrontal ..... 2.
2. Anterior part of parafrontals conspicuously silvery; frontal vitta narrowed anteriorly to a line scarcely wider than lowest ocellus.
   (male) **leucocephala** (Rossi).
   Anterior part of parafrontals gray or leaden pollinose; anterior part of frontal vitta at least three times as wide as lowest ocellus ..... 3.
3. Pollinose area of parafrontals sharply limited posteriorly at level of lowest orbital bristles ..... (male) **opaca**, new species.
   Pollinose area of parafrontals not sharply limited posteriorly and continuous over vertex ..... (female) **leucocephala** (Rossi).
4. Hind cross-vein strongly oblique to section of fourth vein before the bend; front, in profile, projects forward from the eye for a distance much less than horizontal diameter of eye ..... 6.
   Hind cross vein nearly perpendicular to section of fourth vein before the bend ..... 5.
5. Front, in profile, projects forward from the eye for distance greater than horizontal diameter of eye ..... **perpendicularis** Van der Wulp.
   Front, in profile, projects forward from the eye for distance not more than one-third horizontal diameter of eye ..... **tessellata**, new species.
6. Palpi, if present, smaller than thickened part of arista; middle tibia lacking bristle on outside below the middle ..... 8.
   Palpi present and distinctly larger than thickened part of arista; middle tibia with a single bristle on outside below the middle; abdomen without yellow spots on its sides ..... 7.
7. First abdominal segment with a pair of strong marginal macrochaetae; middle tibia below its middle with an encircling whorl of three bristles; male with several long wavy hairs on outside of fore tarsus .....
   campestris (Fallén).
   First abdominal segment without median marginal macrochaetae; middle tibia lacking whorl of three bristles near its middle; male without conspicuous long wavy hairs on outside of fore tarsus ..... **inermis**, new species.
8. With very small distinct palpi; males with long hairs or bristles arising from fore tarsus ..... 9.
   Without palpi, though sometimes with stubby rudiments; abdomen yellow on sides; males lacking long hairs or bristles on the fore tarsus .....
   sinipalpis, new species.
9. Abdomen with pronounced yellowish spots on the sides; male with several long bristles on upper side of fore tarsus ..... **lateralis** (Macquart).
   Abdomen usually wholly black; male with several long hairs on outside of fore tarsus ..... **lateropili**, new species.

METOPIA LEUCOCEPHALA (Rossi)

Musca leucocephala Rossi, Fauna Etrusca, vol. 2, p. 306, No. 1504, 1790, Type from Europe.

Metopia leucocephala Meigen, Illig. Mag., vol. 2, p. 280, 1803.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 127, 1897.—Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 511–512, 1907, contains a full list of numerous references in European literature and 14 names of Robineau-Desvoidy assigned to synonymy.—Melander and Brues, Biol. Bull., No. 5, p. 20.—Smith, Ins. of New Jersey, p. 782, 1909.—Thompson, Can. Ent., vol. 43, pp. 313–314, 1911.—Aldrich, An. Ent. Soc. Amer., vol. 8, p. 83, 1915.—

ADAMS, Bull. Ill. Nat. Hist. Survey, vol. 11, p. 195, 1915.—REINHARD, Ent. News, vol. 30, p. 282, 1919.—COLE and LOVETT, Proc. Cal. Acad. Sci., vol. 11, p. 303, 1921.—BRIMLEY, Ent. News, vol. 33, p. 24, 1922.

Ophelia xychus WALKER, ? List 4, p. 70, 1849, after Aldrich.

Metopia roseri RONDANI, Dipt. Ital. Prodr., vol. 3, p. 210, 1859, after Bezzi and Stein.

Metopia luggeri TOWNSEND, Canad. Ent., vol. 24, p. 69, 1892.

Metopia meridiana TOWNSEND, Proc. U. S. Nat. Mus., vol. 43, p. 361, 1912. After examination of type series at the National Museum.

There are only two North American species of the genus, so far discovered, *leucocephala* and *opaca*, in which the frontal vitta at the middle is distinctly narrower than either parafrontal. In the male of *leucocephala* the frontal vitta is obliterated anteriorly, while the front on either side is conspicuously silvery. In the female, the vitta is not constricted to a narrow line anteriorly, and the front is not conspicuously silvery. The palpi are black and distinctly larger than the thickened part of the arista. Thorax and abdomen are black, moderately pollinose and distinctly tinged with bronze. No yellow spots occur on the sides of the abdomen; the first two segments with a median marginal pair of bristles, the third with one or two laterals and a median marginal pair but never with an uninterrupted marginal row, the fourth with a marginal row of about eight. Wings hyaline; the hind cross vein nearly parallel to section of fourth vein beyond the bend. Legs black; front tarsus of male without long erect bristly hairs, or abnormally reduced joints; middle tibia with one strong bristle on outer front side near the middle.

My notes on this species are based on the examination of several hundred specimens from all parts of the continental United States, southern Canada, Cuba, a few adults collected by Townsend in Peru and deposited in the United States National Museum (*M. meridiana*) and several specimens from Europe including some determined by Professor Bezzi. Types of *leucocephala*, *Q. xychus* Walker and *roseri* Rondani as well as the numerous types of Robineau-Desvoidy which serve to swell the synonomy of this species, not seen, and their exact location not known to me.

Range.—Throughout continental United States; Newfoundland, southern Quebec and British Columbia, Canada; Peru; Europe.

The characteristics of the first instar maggots in the specimens studied by me agree in all but a few minor points with the descriptions and figures published by Thompson.[24] I have examined several uterine maggots and find that the lateral hook does not have a blunt serrated tip as figured by Thompson but ends in a blunt point apposed to the tip of the median hook. The denticles, about mid-

[24] Paris Edition du Bull. Biol. de la France et de la Belgique, Recherches sur les Diptères Parasites, p. 111, fig. 105, 1921.

way on the keel of the median stylet, so prominent in Thompson's figure, are lacking in my specimens. In the buccopharyngeal apparatus, the same parts occur, and in very nearly the same relative size and conformation as in the various species of *Senotainia*. The cuticula is found to possess, on every segment, an anterior band of flat, nearly transparent microscopic scales followed by a wider band of longitudinal corrugations, as in *Senotainia*. There are no heavily chitinized spines on the cuticula at any point. The uterine larvae are about 0.8 mm. long and the buccopharyngeal apparatus is one-fourth the length of the body. The other larval instars and the puparium of this species have not been studied.

The adults frequent sunlit, barren spots on low fertile soil surrounded by luxuriant herbaceous vegetation, such as denuded spots in a weedy field, or in such crops as rape and cowpeas. In such places the adults may be found in large numbers, darting about just above the surface of the soil, alighting now and then on the soil or on short dry sticks arising from the ground. They are not known to be attracted to flowers. On one occasion they were found in great abundance on rape, apparently attracted by a flow of honeydew from the heavy infestation of plant lice present.

M. leucocephala has been reported parasitic in the nests of the "sweat bees," on *Halictus sexcinctus* in Pomerania [25] and on *H. pruinosus* in Massachusetts.[26] The latter record is by Melander and Brues, who state that the adult fly chooses "the moment when the incoming bee pauses at her threshold, quickly and quietly to oviposit on her pollen mass and thus infect her offspring." This species has also been observed hovering over the burrows of *Chlorion atratum* Lepeletier while the latter was digging in sand [27] and Adams is credited with the observation that the larvae of *Chlorion ichneumoneum* are devoured by the *Metopia* maggots.[28] Bezzi states that in Europe, *M. leucocephala* has been reared from *Bembix*, *Halictus* and *Philanthus*.[29]

METOPIA OPACA, new species

Male.—Front 0.39 of head width (measurements of five 0.37, 0.38, 0.40, 0.40, 0.40); vertex and upper part of parafrontals dull black, sharply defined from the dull leaden gray pollen of the anterior portion of parafrontals which is continuous down over face and bucca; frontal vitta black, not obliterated anteriorly, but narrowed to near base of antennae where it is nearly as wide as ocellar triangle, at level of lowest orbitals it is third width of parafrontal; about eleven bristles in frontal row which extends to below insertion of arista,

[25] Ridel, Allg. Zeitsch. f. Ent., vol. 6, p. 152.
[26] Biol. Bull., no 5, p. 20, 1903.
[27] Adams, Ill. Nat. Hist. Surv. Bull., no. 11, p. 195, 1915.
[28] Rau and Rau, Wasp Studies Afield, p. 197, 1918.
[29] Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 511, 1907.

widely divergent below, with an irregular group of several bristles within its angle of divergence, two bristles near middle of frontal row much larger than those on either side; one to three or more proclinate and about the same number of reclinate orbitals inserted irregularly on that part of parafrontal devoid of pollen; vertex and upper part of front thickly black setulose, pollinose part of front sparsely so; antennae black, third joint seven times length of second; arista thickened on basal two-fifths; parafacials densely black setulose on upper half, with usual row of stout bristles extending downward to level of uppermost bristle on facial ridge; in profile, buccal width much greater than that of parafacials at narrowest and equals one-fourth eye height, front projects for distance nearly equal to horizontal eye diameter; palpi black, larger than the thickened part of arista. Thorax gray pollinose merging with bronze on mesonotum and scutellum, with four black vittae of about equal width, the inner pair divergent posteriorly and terminating at transverse suture. Abdomen densely gray pollinose, tinged with bronze on notum; pollen of first three segments interrupted by transverse rows of two to three large black spots, which on the intermediate segments coalesce in the form of a letter "E," last segment polished black on apical third; first two segments with strong median marginal bristles, third with a strong median marginal pair and one or two pairs of strong laterals which fail to complete an uninterrupted marginal row, fourth with the usual marginal row. Wings subhyaline; hind cross-vein oblique to section of fourth vein before the bend, parallel to section beyond bend; third vein bristly more than half way to small cross-vein. Fore tarsus without conspicuous long bristly hairs on the side; middle tibia with one prominant bristle on outer front side beyond middle; hind tibia on outside with row of about twelve uneven bristles extending from base to apex.

Female.—Not known.

Length, 6.5 to 7.0 mm.

Type.—Male. Cat. No. 28153, U.S.N.M.

Range.—Oregon, Montana, Ontario.

Host relationships.—Unknown.

Described from the following material: three, including the type, Marshfield, Oregon, VI–27 (J. M. Aldrich); one, Marshfield, Oregon, VI–28 (J. M. Aldrich); one, Summit Station, Montana, 5,200 feet, VII–25 (J. M. Aldrich); all in the National Museum: one, Ottawa, Ontario, 26–VII–1924 (C. H. Curran), in the Canadian National Collection.

The male closely resembles *leucocephala* in the rather striking, conical-shaped head. It may be readily separated, however, by its peculiar leaden pollinose front and the greater width of the frontal vitta anteriorly. It may be possible that females have been placed

with *leucocephala*, since the only differences detected in those two species occurs in a region markedly different in the two sexes.

METOPIA CAMPESTRIS (Fallén)

Tachina campestris FALLÉN, Dipt. suec. Musc., col. 8, p. 12, 1820.—BEZZI and STEIN, Kat. Pal. Dipt., vol. 3, pp. 510–511, 1907. Contains many references in European literature for which there is not space in this paper.
Tachina amabilis MEIGEN, Syst. Beschr., vol. 4, pp. 374, 232, 1834.
Ophelia cinerea ROBINEAU-DESVOIDY, Myod., p. 121, 1830.
Ophelia gracilis ROBINEAU-DESVOIDY, Myod., p. 121, 1830.
Ophelia lutescens ROBINEAU-DESVOIDY, Myod., p. 121, 1830.
Metopia flavescens MACQUART, Soc. Sci. Lille, 1833, p. 285, 1834.
Metopia crassicornis PERRIS, Soc. Linn. Lyon, 1852, p. 63.
Metopia staegeri RONDANI, Dipt. Ital. Prodr., vol. 3, p. 210, 1859.
Ophelia caesia ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 96, 1863.
Ophelia demissa ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 98, 1863.

Male.—Front at narrowest 0.30 of head width (measurements of five 0.29, 0.30, 0.30, 0.30, 0.31); front, face, and bucca gray pollinose with dark reflections when viewed from below; inner orbits strongly approximated at base of antennae, diverging widely towards vertex and bucca; frontal vitta black, diverging moderately toward the rear, about twice width of either parafrontal at level of lowest orbitals; about ten bristles in frontal row, which extends to middle of second antennal joint; parafrontals moderately pilose, with the black bristly hairs extending downward to insertion of arista; vibrissae level with front edge of oral margin; facial ridges with two or three bristles not extending above the lowest fourth; antennae black, extending to half the length of second antennal joint from vibrissae; third joint five to seven times as long as the second; arista thickened on basal two-fifths; in profile, bucca equals one-eighth eye height and is subequal to parafacials at narrowest point, front projects about one-third eye diameter; parafacials bare save for row of strong macrochaetae extending downwards to level of uppermost bristles on facial ridges; palpi black, much larger than thickened part of arista. Thorax thinly gray pollinose over black, with two narrow median and two broad lateral vittae before the transverse suture, and three broad vittae behind the suture which are obscurely continuous over the scutellum; the apical and lateral pairs of marginal scutellar bristles equal and both smaller than the intermediate marginal pair; small preapicals present. Abdomen shining black, with broad, reflecting, bronze-tinged gray pollinose bands on basal two-thirds of the last three segments; intermediate segments with a median vitta and usually with large V-shaped indentations in the pollinose bands on either side, when viewed from rear; first and second segments each with a strong median marginal pair of bristles; third and fourth each with uninterrupted marginal row of about ten bristles. Genitalia (pl. 1, fig. 2) black; in repose extruding but slightly from the fourth abdominal

segment; first genital segment nearly bare save for subapical row of small bristly hairs; second genital segment and the base of inner forceps densely covered with fine bristly hairs; inner forceps in lateral view tapering somewhat abruptly to the middle and then more gradually to nearly straight, strong tips; from the rear the claws appear conical and are moderately divergent from near the base; outer forceps yellowish, shorter than the inner pair, with spoon-shaped tips; fifth sternite enlarged and possessing a broad U-shaped cleft. Wings hyaline; fourth vein beyond the bend moderately arcuate, nearly parallel to hind cross-vein; last section of fifth vein distinctly less than half the preceding section; third vein bristly at least half way to the small cross-vein. Legs black; first four joints of front tarsus with several long slender erect hairs on outside (pl. 3, fig. 19); middle tibia near its middle with encircling ring of one weak and two strong macrochaetae; hind tibia on outside with a row of unequal bristles extending from base to apex.

Female.—Front at narrowest 0.36 of head width (measurements of five 0.35, 0.35, 0.36, 0.37, 0.39); inner orbits nearly straight and parallel, scarcely more nearly approximated at base of antennae than elsewhere; third joint of antennae five to six times length of second. Fore tarsus without long erect hairs on the outside. Otherwise, save for the usual differences of external genitalia, like the male.

Length, 5.0 to 6.5 mm.

Range.—Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Maryland, District of Columbia, Virginia, Pennsylvania, Ohio, Michigan, Wisconsin, Colorado, Idaho, California, Europe.

Host relationships.—Unknown.

I have examined material from the following localities. Two specimens from Franconia, New Hampshire (C. H. T. Townsend); one, Lexington, Massachusetts; two, North Saugus, Massachusetts (D. C. Clemons); three, Waterbury, Connecticut (C. H. T. Townsend); a large series from Slaterville, Duck Lake, and McLean Bogs, New York (L. S. West); two, Plummer Island, Maryland (W. L. McAtee, H. L. Vierick); two, Rock Creek, District of Columbia (C. H. T. Townsend); one, Beltsville, Maryland (N. Banks); one, Great Falls, Virginia (H. W. Allen); one, Difficult Run, and one, Dead Run, Virginia (R. C. Shannon); one, Ravensworth, Virginia (C. H. T. Townsend); one, Battle Creek, Michigan (J. M. Aldrich); three, Polk County, Wisconsin (Baker); two, Peaceful Valley, Colorado (Cockerell); one, Tennessee Pass, Colorado, three, L. Metigoshe, Turtle Mountains, North Dakota, one, Moscow, Idaho, and one, Mount Lowe, California (J. M. Aldrich); one, Humboldt County, California (H. S. Barber); all in the collection of the National Museum. In the collection of the Boston Natural History Society, I have seen specimens from several

places in Massachusetts: Mount Desert Island, Machias, Northeast Harbor, Maine; Manchester, Vermont: In Dr. C. W. Johnson's collection, specimens from Pennsylvania and New Jersey: In the collection at the Museum of Comparative Zoology at Cambridge, Massachusetts, a long series from Vermont, Massachusetts, New Jersey, and several localities in Virginia: In the collection of Prof. J. S. Hine, one specimen from Wauseon, and another from Johnson's Island, Ohio: In my collection, specimens from Lunenburg and Amherst, Massachusetts; Shenadoah River, Clarke County, and Great Falls, Virginia; and Columbus, Ohio.

European specimens determined by Professor Bezzi and deposited in the National Museum, I have examined and find to differ from the North American specimens only in possessing several rather weak marginal macrochaetae on the first and second abdominal segments lateral to the strong median marginal pairs. This in my opinion is not of sufficient significance to be considered a specific difference.

The identity of the American species with the European *campestris* was pointed out to me by Dr. J. M. Aldrich. In this country it has long been confused with *leucocephala*. Apparently Thompson had *campestris* in mind in his short paper on *M. lateralis*,[30] but a careful comparison with the description of Macquart indicates that the latter refers to another species. The synonomy submitted is after Bezzi and Stein; the types have not been examined by me.

METOPIA INERMIS, new species

Male.—Front in the single specimen measured 0.32 of head width; front, face and bucca gray pollinose; frontal vitta black, at lowest orbitals twice width of parafrontal; about ten bristles in frontal row which extends to middle of second antennal joint, with one or two bristles in the angle of divergence; parafrontals with sparse black bristly hairs to insertion of arista; facial ridges with two or three bristles not extending above the lowest fourth; antennae black, third joint three times length of second; arista thickened on basal third, penultimate joint slightly longer than broad; in profile, bucca wider than parafacials at narrowest and equal to one-sixth eye height, front projects forward from eye for distance greater than one-third horizontal eye diameter; palpi black, distinctly larger than thickened part of arista. Thorax gray pollinose, notum black, subshining, with four broad black vittae; scutellum with the intermediate marginal bristles larger than the equal apical and lateral pairs; small preapicals present. Abdomen black; last three segments with black polished apices and densely gray pollinose bases, the intermediate segments each marked with a series of three triangular spots coalesced at apex

[30] Canad. Ent., vol. 43, pp. 313-314, 1911.

in form of a trident, pollen not tessellated or changing color when rotated in the light; first segment without apical marginals, second with a strong pair, third with an apical pair and several laterals, which are nearly as strong as the median marginals, not completing an uninterrupted marginal row. Genitalia, in repose, not extruding beyond tip of abdomen; both genital segments black. Wings hyaline; last section of hind cross vein sinuous and strongly oblique to section of fourth vein before the bend, parallel to section beyond the bend; third vein bristly more than half way to small cross vein. Legs black; fore tarsus without conspicuous long bristly hairs on outside; middle tibia with one rather weak bristle on outside beyond middle but lacking a whorl of three at this place; hind tibia on outside with row of about ten unequal bristles extending from base to apex.

Female.—Front in one specimen measured 0.34 of head width; frontal vitta at level of lowest orbitals one and one-half times width of parafrontal; third antennal joint four times length of second; buccal width one-ninth eye height. Last three abdominal segments with broadly polished apices, trident-shaped marks indistinct. Hind tibia on outside with seven bristles. Otherwise, except for usual differences of genitalia, like the male.

Length, 5.0 to 6.0 mm.

Type and allotype.—Cat. No. 28154 U.S.N.M.

Range.—Utah, Maryland.

Host relationships.—Unknown.

Described from the two specimens—the male type from Soldier's Summit, Utah, 7,454 feet, July 6 (J. M. Aldrich) and female allotype from Chesapeake Beach, Maryland, August 19, 1919 (J. M. Aldrich). The female exhibits minor variations from the male, but possibly not more than might be explained by the wide difference in habitat. It is at least much more nearly related to the type of *inermis* than to any other North American species studied. From the closely related *campestris*, this species may be readily distinguished by the shorter third antennal joint, and by the lack of median marginal bristles on the first abdominal segment, the lack of an encircling whorl of three bristles on the middle tibia and the absence of conspicuous bristly hairs on the outside of the fore tarsus.

METOPIA TESSELLATA, new species

Male.—Front 0.34 of head width (measurements of three 0.33, 0.34, 0.36); front and face gray pollinose with dark reflections; vitta black or brown, at level of lowest orbital bristles three to five times width of parafrontal; parafrontals sparsely black setulose to below uppermost macrochaetae of parafacial row; antennae black, third joint five to six times length of second; arista thickened on basal third; in profile, bucca wider than parafacials at narrowest, and

equal to one-eighth eye height, front projects slightly more than one-third eye width; palpi black, of normal size. Thorax gray pollinose tinged with brown on notum, with four broad black vittae, the outside pair of which extend to scutellum, inner pair not extending beyond transverse suture. Abdomen black, somewhat flattened dorsoventrally; intermediate segments pollinose to apices, pollen strongly tessellated, changing abruptly from bronze to gray when rotated in the light, last segment pollinose on basal two-thirds; first segment without macrochaetae, second with a strong median marginal pair, third with a strong median marginal pair and several distinctly weaker ones on either side, in some specimens forming an uninterrupted marginal row, fourth with marginal row of bristles which increase gradually in size towards the median dorsal line. Wings subhyaline; hind cross vein straight and nearly perpendicular to fourth vein, which it joins almost halfway between its bend and the small cross vein; Third vein bristly nearly to small cross vein. Tarsus of fore leg slender, without conspicuous long bristly hairs on the outside; middle tibia with one small bristle on outer front side beyond middle but lacking an encircling whorl of three at this place; hind tibia on outside with a row of about nine unequal bristles extending from base to apex.

Female.—Front at narrowest 0.40 of head width (measurements of six 0.37, 0.37, 0.41, 0.41, 0.42, 0.42). Otherwise, except for the usual differences in genitalia, like the male.

Length, 5.5 to 7.0 mm.

Type.—Male, Hinckley, Ohio, VI–29–'01 (J. S. Hine) in the collection of Professor Hine.

Allotype.—Female, Hinckley, Medina County, Ohio, VI–29–'01 (J. S. Hine), also in the collection of Professor Hine.

Range.—Maine, Massachusetts, New York, Ohio, Maryland, Virginia.

Host relationships.—Unknown.

Described from the following material: in the collection of Professor Hine; one male and one female from Hinckley, Ohio: in the collection of Dr. C. W. Johnson; one male, Machias, Maine, VII–21 (C. W. Johnson); one female, New Bedford, Massachusetts; two females, Chester, Massachusetts, VII–25–'12 (C. W. Johnson); in the collection of J. R. Malloch, one male, Glen Echo, Maryland, Aug. 21, 1923 (J. R. Malloch): in the collection of R. C. Shannon, one female, Renwick, Ithaca, New York, 19–VIII–'21 (L. S. West); in my collection, one female, Great Falls, Virginia, 15–VIII.

This species very closely resembles *inermis* from which it can be distinguished by the greater length of the third antennal joint, the wider frontal vitta, the distinctly tessellated and more extensively pollinose abdomen and the presence of a perpendicular hind cross

vein. From *campestris* it may be readily distinguished by the absence of median marginal bristles on the first abdominal segment, the absence of a distinct whorl of three bristles on the middle tibia beyond the middle, in the comparatively weaker development of macrochaetae on the third abdominal segment laterad of the median marginal pair and in the presence of the perpendicular hind cross vein. Male differs further in having no conspicuous long bristly hairs on the side of the fore tarsus.

METOPIA LATEROPILI, new species

Male.—Front at narrowest 0.325 of the head width (measurements of two 0.31 and 0.34, respectively); front and face silvery pollinose with dark reflections toward vertex; inner orbits most nearly approximated at base of antennae, diverging slightly toward vertex, widely towards bucca, with a concavity to accommodate the bulging parafacials; frontal vitta black, pollinose anteriorly, diverging slightly to middle, thence with parallel sides to vertex, width at lowest orbitals one and one-half to two times that of either parafrontal; about ten bristles in frontal row which closely borders the vitta, upper five or six bristles much the smallest; front with sparse black bristly hairs outside the frontal rows; vibrissae at level of front edge of oral margin; antennae black, extending to one-half length of its second joint from vibrissae, third joint four to five times as long as the second; arista thickened on basal two-fifths; parafacials bare save for row of strong bristles near facial ridges extending downward to level of uppermost bristles of the facial ridges; in profile, buccal width equals parafacials at narrowest, and is approximately one-tenth the eye height: front projects one-third the horizontal eye diameter; palpi yellow, filiform, and distinctly more slender than the thickened part of arista. Thorax thinly pollinose over shining black, notum bronzed and obscurely marked with three narrow median and two broad lateral vittae; scutellum uniformly bronze pollinose, with three pairs of nearly equal marginal bristles, no distinct preapicals. Abdomen black, without red or yellow spots on the sides, last three segments with gray pollinose bands on the basal two-thirds which are divided by an indistinct black vitta on the intermediate segments; second and third segments each with a median marginal pair of bristles, fourth segment with a marginal row of about eight. Genitalia small, black, in repose not extruding from the tip of the abdomen. Wings subhyaline; section of fourth vein beyond the bend slightly arcuate, oblique to hind cross vein; last section of fifth vein nearly half as long as preceding section; third vein bristly more than half way to small cross vein. Legs black; fore tarsus with several long slender erect hairs on the sides of the second, third, and fourth joints, fourth joint not conspicuously reduced; middle tibia lacking bristles on

front side near middle; hind tibia on outside with row of about five uneven bristles extending from base to apex.

Female.—Front at narrowest 0.346 of head width (measurements of three 0.33, 0.35, and 0.36); fore tarsus lacking the long erect hairs on the outside. Otherwise, except for usual differences of genitalia, like the male.

Length, 4 to 5 mm.

Type, Allotype, and Paratypes.—Cat. No. 28155, U.S.N.M.

Range.—Louisiana, Texas, New Mexico, Cuba.

Host relationships.—Unknown.

Described from two males (one type) and four females (one allotype) Havana, Cuba (Baker); one male, Shreveport, Louisiana, July 3, 1890 (F. W. Mally); one male, Kennedy, Texas, May 4, 1896 (Marlatt); and one male, Las Vegas, New Mexico, Aug. 17 (Barber and Schwarz); all in the National Museum.

The female of this species and of *M. lateralis* are sometimes difficult to separate since the presence of red or yellow on the sides of the abdomen and the color of the palpi seems to be a rather variable character. Males, however, are readily separated on the ornamentation of the fore tarsus.

METOPIA LATERALIS (Macquart)

Degeeria lateralis Macquart, Dipt. Exot. Suppl., vol. 3, p. 208, pl. 5, fig. 6, 1847. From North America.

Metopia lateralis Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 127, 1897. As synonym of *leucocephala.*—Aldrich, Cat. N. A. Dipt., p. 476, 1905. Questions whether equals *leucocephala.*—Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 512, 1907. Synonym of *leucocephala.*

Parametopia morrisoni Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 619, 1914.

Male.—Front at narrowest 0.34 of head width (measurements of five 0.32, 0.32, 0.33, 0.35, 0.36); frontal vitta black, broadening slightly toward the rear, at middle more than twice as wide as either parafrontal; parafrontals gray to golden pollinose; frontal row with nine to eleven bristles extending to slightly below base of second antennal joint; numerous small black bristly hairs on front, more plentiful near base of antennae; vibrissae near oral margin; antennae black, extending to length of second antennal joint above front edge of oral margin; third joint four to five times as long as second; arista thickened on basal two-fifths, with short pubescence in middle; palpi smaller than thickened part of arista, filiform and usually black; in profile, front projects forward about one-fourth horizontal diameter of eye, bucca equals one-fifteenth of eye height; parafacials gray pollinose, bare save for the usual row of strong macrochaetae near the facial ridges which extend downward more than half way to vibrissae, but usually not reaching the level of the uppermost bristles of the

facial ridges. Thorax gray pollinose, golden tinged, with three narrow, black median and two broad lateral vittae; scutellum with three pairs of marginal bristles of about equal size. Abdomen black, with a large yellowish spot extending over the sides of the first two and sometimes the third segments; basal two-thirds of last three segments gray pollinose when viewed from rear, the gray interrupted by black median dorsal V-shaped emarginations; first segment usually lacking macrochaetae, second and third each with a median marginal pair, fourth with a marginal row of about eight. Genital segments black, subshining, sparsely covered with black bristly hairs; in repose, retracted within the last abdominal segment; inner forceps small, black, densely covered at base with fine black hair, claws tapering to slender curving points, divergent at tips, and when viewed from the rear display no angle on the outside near the base; outer forceps brown, shining, larger and stouter than the inner pair; anterior claspers unusually long, more slender than the largest of the abdominal bristles, curved forward and slightly enlarged at the extreme tip. Wings hyaline; fourth vein veyond the bend slightly arcuate and nearly parallel to hind cross-vein; third vein with a row of small bristles, extending in some specimens more than half way to small cross-vein. Legs black, trochanters and frequently the upper part of femora yellow; second, third, and fourth joints of fore tarsus each with an erect bristly hair on the upper surface; fourth joint much reduced; middle tibia lacking macrochaetae on outer front side near the middle; hind tibia on outside with an uneven row of five to nine bristles extending from base to apex.

Female.—Front at narrowest 0.33 of head width (measurements of three 0.31, 0.33, 0.35 respectively); frontal vitta pollinose, nearly concolorous with parafrontals. Genitalia nonpiercing, in repose inconspicuously telescoped within the fourth abdominal segment.

Length 3.5 to 6.0 mm.

Specimens have been examined in the collections of the National Museum, Nathan Banks, and the writer, from the following localities: One female, White Mountains, New Hampshire (Morrison), type of *Parametopia morrisoni* Townsend; one male, Melrose Highlands, Massachusetts, July 31, and one female, West Springfield, Massachusetts, July 13, 1915 (H. E. Smith); two males and two females, Lafayette, Indiana; one male, Columbus, Ohio, Aug. 4, 1921 (H. W. A.); one male, New York, late July; one male, Linnieville, Maryland, July 4, 1913, and one female, Cabin John, Maryland (R. C. Shannon); one female, Rock Creek, District of Columbia (C. H. T. Townsend); three males, Chain Bridge, Virginia, August 12, 1923 (H. W. A.); eight females and two males, Fall Church, Virginia (N. Banks); one female, Lawrence, Kansas; one female, Birmingham, Alabama, June 4, 1917 (J. M. Aldrich); one male, Agricultural and Mechanical

College, Mississippi, April 23, 1921, and two females, Meridian, Mississippi, Sept. 3, 1922 (H. W. Allen); one female, White Springs, Florida, Oct. 17 (C. H. T. Townsend); one female labeled "Parker Note no. 45," from Brookland, District of Columbia.

The type not seen and its present location not known to me. Marquart describes the species as having the sides of the abdomen rufous, and the palpi black, a combination of characters present in the above specimens but not found in any of the other North American species known to me. This common species has been long confused with *leucocephala* and *campestris*. In his Revision of the Tachinidae, Coquillett considers it synonymous with the former.[31] Somewhat later, Thompson [32] pointed out characters distinguishing it from *leucocephala* but failed to distinguish *lateralis* and *campestris*.

The known range of *lateralis* covers a large part of the eastern United States from New Hampshire, New York, Ohio, Indiana, and eastern Kansas to Mississippi and northern Florida. It has also been reported in Quebec.[33] Adults of this species occur quite abundantly in sunlit spots, on the foliage of low shrubs and herbaceous plants, in open deciduous forest, or flying about just above the ground covering of dead leaves. It has also been taken, with other *Miltogramminae*, in sandy spots in open grassy pasture. Nathan Banks reports having collected it frequently feeding on honeydew on the dead leaves and low foliage under tulip tree, and the writer has taken it under the same conditions.

METOPIA SINIPALPIS, new species

Male.—Front at narrowest 0.33 of the head width (measurements of five 0.29, 0.33, 0.34, 0.35, 0.36); frontal vitta black, pollinose anteriorly, with sides parallel except near base of antennae, at lowest orbitals three to four times as wide as either parafrontal; parafrontals somewhat golden pollinose, with dark reflections when viewed from the front; nine to eleven bristles in the frontal row which extends to slightly below base of second antennal joint; a few black bristly hairs on parafrontals, more abundant at the extreme front, not extending below the upper half of the parafacials; vibrissae level with front edge of oral margin; facial ridges with three small bristles on the lowest fourth; antenna black, extending to less than length of its second joint above front edge of oral margin, third joint three or four times as long as the second; arista thickened on basal one-fourth; parafacials with a row of macrochaetae near the facial ridges, which extend from the base of the third antennal joint to level of the uppermost bristle of the facial ridge; in profile, bucca scarcely one-twelfth eye height; proboscis scarcely one-half head height; palpi lacking,

[31] U. S. Bur. Ent. Tech. Ser., No. 7, p. 127, 1897.
[32] Canad. Ent., vol. 43, p. 313, 1911.
[33] Ent. Soc. Ont. Rept., 1922, p. 69.

or at most represented by rudimentary stubs. Thorax gray pollinose over black, the notum subshining, distinctly tinged with bronze, with three narrow median and two broad lateral vittae, the lateral one extending beyond the transverse suture; scutellum with three pairs of marginal bristles of about equal size. Abdomen black, broadly yellow on the sides of the first three segments, last three segments gray pollinose except for the narrow apices which are shining black, and a narrow dorsal vitta on the second and third segments; first segment without bristles, second and third segments each with a strong median marginal pair, third sometimes with a weak lateral bristle, fourth with a marginal row of six to eight bristles. Genitalia black; first genital segment slightly larger than the second; the subdiscal part of the first, the second and the base of the inner forceps clothed with black hairs somewhat finer than those of the abdomen; two small apical bristles on the first segment; inner forceps expanded laterally into a small but distinct angle near the base, plainly seen from the rear; anterior claspers extremely long, boomerang-shaped, not expanded at the tip, much stouter than the abdominal macrochaetae. Wings hyaline; section of fourth vein beyond bend moderately arcuate and nearly parallel with hind cross vein; last section of fifth vein less than half as long as preceding section; third vein bristly more than half way to small cross vein. Legs black, the trochanters, upper half of the femora and the front tibia usually yellow; front tarsus without conspicuous bristles or long hairs; middle tibia lacking bristles on outer front side near middle; hind tibia on outside with four or five bristles extending beyond the middle.

Female.—Front at narrowest 0.32 of head width (measurements of four 0.31, 0.32, 0.32, 0.33, respectively). Otherwise like the male except for the usual differences in external genitalia.

Length, 4.5 to 6.0 mm.

Described from the following material. In the collection of the National Museum, one male, North Wilbraham, Massachusetts, Aug. 15, 1916 (D. A. Ricker); one male and four females from Lafayette, Indiana, one male, Chesapeake Beach, Maryland, June 21, 1923 (J. M. Aldrich); one female, Cupid's Bower Island, Maryland, July 8, 1915 (R. C. Shannon); one male, Chain Bridge, Virginia (H. W. A.); one male, Onaga, Kansas; one female, Opelousas, Louisiana, May, 1897. From Glen Echo, Maryland, one male, July 1, 1923, one male, August 10, 1923, one male, Aug. 21, 1923, one male and one female, Aug. 30, 1923, in the collection of J. R. Malloch. One male, Fort Andrews, Ohio, June 10–12, 1902; one male, Vinton, Ohio, June 5–12, 1900; two females, Cincinnati, Ohio; two from Hinkley, Medina County, Ohio; one from Wauseon, Ohio, Sept. 2, 1902; in the collection of Prof. J. S. Hine. One male, Dead Run, Fairfax County,

Virginia, June 16 (N. Banks); one female, Falls Church, Virginia, Sept. 10 (N. Banks); and one male, North Wilbraham, Massachusetts, Aug. 15, 1916 (D. A. Ricker); all in collection of Nathan Banks. Two males and one female, Chain Bridge, Virginia, Aug. 12, 1923 (H. W. Allen); one male and one female, Great Falls, Virginia; in my collection.

Type and allotype.—Cat. No. 28156 U.S.N.M., Chain Bridge, Virginia, August 12 (male type) (H. W. Allen); July 6 (allotype) (J. M. Aldrich).

The present known range of this species is from Massachusetts, Indiana, and eastern Kansas southward to Virginia and Louisiana. The writer has found the adults common on the high rocky bluffs of the Potomac River, where they may be found on low foliage, in sunlit spots, in open deciduous forest. In the same region they are not commonly encountered in open fields, either on vegetation or denuded ground. However, one specimen from Massachusetts, collected by D. A. Ricker, is labeled "clover." Another specimen examined, collected by Doctor Aldrich is labeled "prey of *Laphria canis*." The host relationships of *M. sinipalpis* are not known.

METOPIA PERPENDICULARIS Van der Wulp

Metopia perpendicularis Van der Wulp, Biol. Cent. Amer., Dipt. vol. 2, p. 115, 1891.

The type, a female specimen from Mexico in the British Museum, not seen by me. From the description and figures, it is recognized as a species of *Metopia* distinct from the others described in this paper. It appears to resemble, rather closely, *campestris* and *inermis*, from which it is readily distinguished by the perpendicular hind cross vein and the more prominent front.

Genus SPHENOMETOPA Townsend.

Sphenometopa Townsend, Smithsonian Misc. Coll., vol. 51, p. 64, 1908. Genotype, *Araba nebulosa* Coquillett.—Coquillett, Proc. U. S. Nat. Mus., vol. 37, p. 607, 1910.

Eumetopia Brauer and Bergenstamm, Zweifl. d. Kaiserl. Mus., vol. 56, p. 114, 1889. Preoccupied in *Rhyncophora*.

Euaraba Townsend, Proc. Biol. Soc. Washington, vol. 28, p. 20, 1915. Genotype, *Araba tergata* Coquillett.

Arabiopsis Townsend, Can. Ent., vol. 47, p. 285, 1915. Genotype, *Arabiopsis cocklei* Townsend.

Araba of Authors not Robineau-Desvoidy, Coquillett, U. S. Bur. Ent., Tech. Ser., no. 7, p. 127, 1897.—Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 508, 1907.—Adams, in Williston's Manual of N. Amer. Dipt., p. 375, 1908.

The genus *Araba* was proposed by Robineau-Desvoidy in 1830, Myodaires (p. 127), to include several species, no genotype being designated. In 1863, Diptères des Environs de Paris (vol. 2, p. 88),

he slightly modified the name *Araba* to *Arabella*, for the sake of euphony, and designated *Tachina argyrocephala* Meigen, the third of the originally included species, as the genotype. Since *argyrocephala* is a synonym of *leucocephala*, the genotype of *Metopia*, *Araba* becomes a synonym of *Metopia*. This synonomy, rather vaguely defined by Coquillett, in his 1910 paper on type species, was recently clearly pointed out to me by Dr. J. M. Aldrich, in correspondence. While the type of *Araba* is unquestionably a *Metopia*, certain species formerly placed in this genus are certainly distinct from *Metopia*. *Eumetopia*, proposed by Brauer and Bergenstamm in 1899, is preoccupied. *Sphenometopa*, proposed by Townsend in 1908, for *Araba nebulosa* Coquillett, appears to be the earliest valid name. After an examination of types, I am of the opinion that *Euaraba* and *Arabiopsis* are congeneric with *Sphenometopa*. The European *fastuosa* Meigen also belongs here.

The characters of this genus based on a study of the European species, *fastuosa* Meigen and three North American species are as follows. Front wider in female than in male; frontal vitta much wider than parafrontals, setulose or hairy on the sides, between the frontal rows and below the ocellar triangle; ocellar bristles very weak or absent; a single frontal row on either side of frontal vitta, descending at least to middle of second antennal joint; orbital bristles present in both sexes; antennae extending nearly to vibrissae; penultimate joint of arista not more than twice as long as wide; facial ridges with strong macrochaetae extending more than half way from vibrissae to base of antennae; head length at vibrissae much less than at base of antennae; parafacials without macrochaetae; proboscis stout and distinctly shorter than head height; no pale hairs at the sides or back of the oral cavity. Thorax with three strong postsutural dorsocentral bristles and two sternopleurals. Intermediate abdominal segments without even, pollinose basal bands. Male genitalia (pl. 1, fig. 4) small, and in repose, scarcely visible in profile view; female with the usual retracted nonpiercing larvipositor. Wings hyaline or with smoky spots; apical cell open and ending far before extreme tip of wing; fourth vein with fold at the bend; last section of fifth vein much less than half as long as preceding section; costal spine absent or minute; only the third vein bristly, and this at most with three to four bristles near its base. Front pulvilli of both sexes less than half as long as the last tarsal joint; basitarsus of fore leg of male (pl. 3, fig. 18) sometimes structurally modified or ornamented; middle tibia with a single bristle on outer front side near middle; hind tibia on outside with a row of uneven bristles extending from base to apex with one bristle near the middle much the largest.

KEY TO NORTH AMERICAN SPECIES OF SPHENOMETOPA

1. Front at base of antennae as wide as either eye ..... 2.
   Front at base of antenna distinctly narrower than either eye; section of fourth vein beyond the bend nearly straight; parafrontal rows not widely divergent below; male with conspicuous smoky spots in the wing, and with the basitarsus of the foreleg expanded into a large triangular segment ..... nebulosa (Coquillett).
2. Middle tibia with only a single bristle on outer hind side near middle; arista thickened to apex ..... 4.
   Middle tibia on outer hind side near the middle with several bristles; arista thickened on basal three-fifths ..... 3.
3. Abdomen with a broad black median vitta bordered with white pollen; basitarsus of foreleg bearing a conspicuous tuft of black hair.
   (male) cocklei (Townsend).
   Abdomen golden pollinose, with a pair of small bronzed spots on the sides of the first three segments; basitarsus of foreleg without ornamentation ..... (female) cocklei (Townsend).
4. Front, including the vitta, conspicuously silvery; thorax black and but thinly whitish pollinose ..... (male) tergata (Coquillett).
   Front and thorax densely golden pollinose, frontal vitta brown.
   (female) tergata (Coquillett).

SPHENOMETOPA TERGATA (Coquillett)

Araba tergata Coquillett, Journ. New York Ent. Soc., vol. 3, p. 103, 1895; U. S. Bur. Ent., Tech. Ser., No. 7, p. 127, 1897.—Smith, Ins. of New Jersey, p. 782, 1909.—Thompson, Recherches sur les Diptéres Parasites, Paris Edition du Bull. Biol. de la France et de la Belgique, pp. 107–108, figs. xxxii, 116, 1921.

Euaraba grisea Robineau-Desvoidy, Townsend, Insecutor Ins. Menst., No. 6, p. 182, 1918 (in error).

In this species the front is somewhat wider than in the other two North American forms, being 0.36, 0.36, 0.36, 0.37, 0.37, with an average of 0.364 of the head width in five males, and 0.41, 0.44, 0.44, 0.44, 0.46, with average of 0.438 in five females. In the male, the inner orbits are narrower at vertex than at base of antennae; the front, including the vitta, and the face are brilliant silvery pollinose; frontal vitta with barrel-shaped outline; frontal rows suddenly divergent below; two proclinate orbitals; arista short plumose, thickened almost to apex, penultimate joint not longer than broad. Mesonotum in front of suture, and scutellum, dull black, while pleura, mesonotum behind the suture and apex of scutellum, are silvery pollinose; scutellum with two pairs of strong marginal bristles, the apicals wanting. Abdomen shining black, with silvery pollen at the lateral basal parts of the first three segments, the fourth with a band of white pollen on basal half; first segment without bristles, intermediate segments with strong median marginals, and fourth with a marginal row. Inner forceps of male genitalia (pl. 1, fig. 4) slightly divergent from near base, somewhat flattended at base, tapering gradually to slender tips, round in cross section; outer for-

ceps shorter and much stouter than the inner, with broadly rounded, spatulate tips; penis with delicate membranous hood, supported by a heavily chitinized rod which is Y-shaped in profile, one arm of the "Y" encircling the basal part of the hood anteriorly; claspers small and sharply pointed. Wings hyaline; apical cell narrowly open; section of fourth vein beyond the bend strongly arcuate; one to three bristles at base of third vein. The female differs strikingly in appearance from the male, having the frontal vitta brown and not barrel shaped in outline; a row of one reclinate and four t five proclinate orbital bristles, of which the anterior pairs are much the largest. Thorax uniformly gray pollinose with two obscure narrow median vittae; scutellum also pollinose with obscure bronzed spots at the sides; on the white pollinose abdomen, the first three segments bear rows of sharply-defined, round, black spots, which are sometimes coalesced in an apical band.

Length, 3.5 to 5.5 mm.

Type.—Male, Cat. No. 3631, U.S.N.M.

The following material has been examined. Type, a male from Algonquin, Illinois (W. A. Nason); two other specimens from Algonquin bearing Coquillett's name and one specimens from Altadena, California, presumably of the type series; one, Franconia, New Hampshire (Mrs. Slosson); three, Lafayette, Indiana, two of which labeled "on log" (J. M. Aldrich); fourteen, Lewiston, and one, Moscow, Idaho (J. M. Aldrich); one, Boulder, Colorado; one Colorado (Coquillett); one, Animas Park, New Mexico, 6,500 feet; all in the collection of the National Museum. One Amherst, Massachusetts, and twelve, Columbus, Ohio, taken largely from rocks in gravel pits and dumps, in the collection of the writer. Specimens from several places in Massachusetts, and from Hampton, New Hampshire, in the collection of the Boston Natural History Society. Specimens from New Jersey in the collection of Dr. C. W. Johnson. Several specimens from Massachusetts and Pennsylvania in the collection of the Museum of Comparative Zoology at Cambridge, Massachusetts.

Thompson [34] finds that the female reproductive apparatus of this species resembles that of the other Miltogramminae studied. In the first instar maggot, the usual longitudinal ribs or corrugations of the cuticula are lacking, and not only the anterior borders but the entire surface of the segments are interspersed with microscopic colorless scales, which under high magnification are seen to be pointed and directed backwards. The buccopharyngeal apparatus is of the same type as that found in *Metopia, Miltogramma,* and other nearly related genera. Grooves in the pharynx are wanting.

[34] Paris Edition du Bull. Biol. de la France et de la Belgique, Recherches sur les Diptères Parasites, p. 107, 1921.

The known range of this species is from New Hampshire and Idaho to New Jersey, Pennsylvania, Indiana, Colorado, and New Mexico. In Massachusetts and Ohio it is known to occur in large numbers about gravel pits, railroad and highway cuts and fills which are denuded or only scantily covered with vegetation, and strewn with rocks and cobblestones. The adults may be seen in such places, darting about just above the surface of the ground in characteristic zigzag flight, and alighting from time to time on rocks or small stones. Adults have not been taken on flowers. The host relationships of this species are not known.

SPHENOMETOPA NEBULOSA (Coquillett)

Araba nebulosa COQUILLETT, Canad. Ent., vol. 34, p. 200, 1902.
Sphenometopa nebulosa TOWNSEND, Smithsonian Misc. Colls., vol. 51, p. 64, 1908.

Male with the front rather narrow, being 0.25, 0.27, 0.31, with an average of 0.28 of head width; front much narrower at base of antennae than at vertex; frontal rows not widely divergent below base of antennae; parafrontals with row of one reclinate and two proclinate orbital bristles back of which is a tuft of erect bristly hairs; arista thickened on basal two-fifths, the penultimate joint distinctly shorter than twice the width. Thorax gray pollinose, obscurely five vittate; scutellum with three pairs of marginal bristles, of which the intermediate pair is much the largest; abdomen flattened dorsoventrally, truncate at apex, black overlaid with dense white pollen, with three conspicuous black spots on dorsum of each one of the first three segments sometimes coalescing apically; intermediate segments, and usually the first with a median marginal pair of bristles, fourth segment with a marginal row. Wings hyaline with small but quite distinct smoky spots at the apex of second vein, the bend of the fourth, the apex of the first, beyond the small cross vein and at the angle of the fifth vein and the hind cross vein, a small niveous spot at extreme tip of wing; apical cell narrowly open; last section of fourth vein straight from bend to margin of wing; one small bristle at base of third vein. Basitarsus of fore leg (pl. 3, fig. 18) conspicuously expanded ventrally into a triangular segment having pale hairs on its ventral margin. The female closely resembles the male, but its front is wider, being 0.32 and 0.34 with an average of 0.33 of head width in two specimens measured; the third antennal joint is slightly shorter, the basitarsus of the fore leg is not modified, and the infuscated spots on the wings are less conspicuous.

Length, 5.0 to 5.5 mm.

Material examined: type, a male from Sierra Madra, Chihuahua, Mexico, and another male from the same locality and apparently of the type series (C. H. T. Townsend); one male and one female, Florrisant, Colorado, labeled "on sand" (S. A. Rohwer); one male

and one female, Animas Pass, New Mexico, 6,500 feet; all in the collection of the National Museum.

This species is a Rocky Mountain and Sierra Madra form concerning the biology of which very little is known. Townsend states that the Sierra Madra specimens were taken in the pine zone at about 7,000 to 7,500 feet elevation. The host relationships are not known.

Two additional males collected July 25, 1925, at Summit, Montana, by J. M. Aldrich; they were found at the edge of a cascade on smooth, wet rocks in the sun. Altitude about 5,000 feet.

SPHENOMETOPA COCKLEI (Townsend)

Arabiopsis cocklei TOWNSEND, Canad. Ent., vol. 47, p. 286, 1915.

Male.—Front at narrowest 0.34 of head width (measurements of three 0.33, 0.33 and 0.35); inner orbits much narrower at vertex than at base of antennae, with pronounced concavity to accommodate bulge in sides of front, and divergent to bucca; frontal vitta barrel-shaped in outline, at middle three to four times width of parafrontals, concolorous with parafrontals which are gray pollinose, a dark reflecting spot below the ocellar triangle on each side of the vitta; the proclinate ocellar bristles scarcely differentiated from the surrounding hairs; a row of about four proclinate and two reclinate orbital bristles of variable sizes; posterior part of front bare of bristly hairs; vibrissae scarcely differentiated from surrounding bristles, inserted slightly above oral margin; facial ridges divergent, with strong macrochaetae on lowest two-thirds; antenna black, extending nearly to vibrissae, third joint three to three and one-half times as long as second; arista thickened on basal three-fifths, penultimate joint nearly twice as long as wide; in profile, width of bucca slightly greater than that of parafacials and equals one-third eye height, front projects one-half horizontal diameter of eye; parafacials setulose on upper half; bucca densely black setulose; palpi black, filiform. Thorax blue-white pollinose over dull black, with two narrow median vittae and densely covered with long bristly hairs; scutellum with three pairs of marginal bristles of which the intermediates are the longest; strong preapicals present. Abdomen strongly flattened, truncate at apex; black, the sides densely blue-white pollinose, middle of dorsum with a broad black vitta which becomes narrower towards apex, a single pair of small bronzed spots, lateral to the vitta, on each of the intermediate segments; first two segments with two to four long median marginal bristles and one or two smaller laterals; third and fourth segments each with a marginal row. Wings slightly infuscated towards base; apical cell narrowly open at tip; last section of fifth vein not nearly half as long as preceding section; two to three bristly hairs at the base of the third vein. Legs black; basitarsus of fore leg with con-

spicuous tuft of black hairs on the heel and fringing the outside; middle tibia with the usual single bristle on the outer front side near the middle and a row of four to five uneven bristles on the outer hind side.

Female.—Front at narrowest 0.43 of the head width (measurements of two 0.42 and 0.44 respectively); front somewhat more golden pollinose, without the conspicuous dark reflections; two rather strong proclinate orbitals differentiated from the surrounding bristles and bristly hairs on the parafrontals; vibrissae at least the length of the second antennal joint above the front edge of the oral margin; third antennal joint equals two and one-half times length of second; in profile, bucca equals one-third eye height. Thorax densely golden bronze pollinose; sparsely short setulose. Abdomen black, densely covered with golden bronze pollen, without a broad black median vitta; a pair of small but distinct bronzed spots towards the sides on the first three segments, fourth pollinose to apex. Front basitarsus without modifications. Otherwise except for usual differences of genitalia, like the male.

Length 5.0 to 6.0 mm.

Type.—Male, Cat. No. 19554. U.S.N.M.

Redescribed from the type, a male specimen from London Hill Mine, Bear Lake, British Columbia, 7,000 feet, July 21, 1903 (J. W. Cockle); two females and one male, Marshall Pass, Colorado, July 18, 1908, 10,856 feet; one female, Tennessee Pass, Colorado, 10,240 feet (J. M. Aldrich); all in the collection of the National Museum.

This Rocky Mountain alpine form has as yet not been collected below 7,000 feet elevation. Little is known of its habits and nothing concerning the host relationships.

Genus PHROSINELLA Robineau-Desvoidy

Phrosinella Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 83, 1863 Genotype (*Tachina*) *nasuta* Meigen from Europe.

Phrosina Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 101, 1863. According to Bezzi and Stein, Kat. Pal. Dipt., vol. 3, p. 513, 1907, preoccupied, and the genotype *argyrina* Robineau-Desvoidy equals *nasuta* which is the genotype of *Phrosinella*.

Euhilarella Townsend, Proc. Biol. Soc. Wash., vol. 28, p. 22, 1915. Genotype *Hilarella fulvicornis* Coquillett.

Inner orbits narrowest at base of antennae, diverging moderately toward vertex and bucca but distinctly pinched in at the lower corners of the eyes; front distinctly narrower in males than in females; frontal vitta strongly divergent posteriorly, at middle wider than parafrontals, usually with distinct wrinkles radiating from base of antennae; a single row of frontal bristles which extends below base of second antennal joint and is suddenly divergent below; orbital bristles, usually one reclinate and two proclinate, present in both

sexes; one pair of proclinate ocellars; vibrissae located near front edge of oral margin, not noticeably approximated; facial ridges with a few scattered hairs on the lowest fourth or less; lunule conspicuous, shield shaped, situated in a deep indentation of the frontal vitta; antennae extending nearly to level of vibrissae; plumosity of arista not longer than its greatest diameter, penultimate joint scarcely longer than wide; in profile, head length at oral margin is much less than at base of antennae, epistoma not prominent; parafacials bare or beset with black bristly hairs; bucca and back of head with black bristly hairs except for sparse white hairs at sides and back of oral cavity; proboscis stout, much shorter than head height, labella fleshy; palpi normal; eyes with the facets at extreme front but slightly larger than those at the sides. Thorax with three strong postsutural dorsocentral bristles and two strong sternopleurals; scutellum with three marginal pairs. Abdomen elongate conical; intermediate segments each with a row of three large spots which are sometimes confluent posteriorly; the basal pollinose band, when present, is always scalloped on the posterior margin as if formed by the coalescing of large spots. Genitalia of male (pl. 1, fig. 6) in repose, scarcely protruding; of female, nonpiercing and retracted. Wings with apical cell open; fourth vein at bend with a distinct fold; last section of fifth vein varies from nearly half to slightly more than half the length of preceding section; third vein with row of small bristles extending more than half the distance from base to small cross vein; a strong costal spine usually present. Pulvilli of both sexes rather short; front tarsus of male (pl. 3, figs. 15, 16) usually ornamented with a peculiar brush of long hairs; of female (pl. 3, fig. 17) strongly flattened; middle tibia with one bristle on outer front side near the middle; hind tibia, on outside with a complete uneven row of bristles.

After study of the North American material and comparison with European specimens of the genotype *nasuta,* it becomes evident that the common species long recognized as *Hilarella fulvicornis* Coquillett and three closely related species described in this paper are much more closely allied morphologically to *nasuta,* than to *hilarella,* the genotype of *Hilarella.* The genotype of *Phrosina* not seen and its present location not known to me. The genotype *fulvicornis* of *Euhilarella* has been compared with specimens of *nasuta* loaned by Professor Bezzi. From the genus *Eumacronychia,* with which it has been confused, *Phrosinella* may be distinguished by the possession of spots instead of even bands on the abdomen, and in having the elongate lunule conspicuously imbedded in a sinus of the frontal vitta, the fore tarsus of the male usually bearing a conspicuous tuft of long bristly hairs, and that of the female without tufts of bristly hairs but usually strongly flattened.

Phrosinella is holarctic in distribution. The species in North America, so far as known, are distinct from those of Europe, and have not been taken outside of the United States. There are four Nearctic species, each with a somewhat restricted range.

The flies of this genus, as far as known, occupy the ground-subterranean stratum, being found in the adult stage largely on barren ground, in and about the holes of burrowing Hymenoptera, rarely on low foliage. They are not commonly attracted to flowers, but at least one species frequently feeds on honeydew. It is believed that they are biologically superimposed upon fossorial Hymenoptera, but reliable rearing records are lacking. Dissections of one species indicate that they deposit large, active maggots. The female of this species has also been observed digging a pit in the sand near the burrows of fossorial Hymenoptera, for which its flattened fore tarsi are admirably adapted. Larvae were deposited in the pit. It seems probable that from this point, they burrow through the soil to the cell of their host, a form of activity which may be correlated with the presence of a conspicuous spiniferous foot on the ventral part of the last segment of the first instar maggots. Pupation takes place in the soil, apparently not far from the cell of the host.

KEY TO NORTH AMERICAN SPECIES OF PHROSINELLA

1. Third antennal joint black ..... 2.
   Third antennal joint bright yellow, rarely overlaid with blackish tomentum. **fulvicornis** (Coquillett).
2. Third abdominal segment with black polished apex which is devoid of pollen ..... 3.
   Third abdominal segment pollinose to apex, at most with small black spots about the marginal bristles; wings distinctly infuscated; thorax and abdomen grayish pollinose with brownish tinge ..... **fumosa**, new species.
3. Front distinctly hairy, many bristly hairs on frontal vitta between frontal rows; males with conspicuous tuft of hairs on underside of second tarsal joint of fore leg, third tarsal joint much thicker and shorter than the fourth. **pilosifrons**, new species.
   Front almost destitute of hairs, vitta bare; males with conspicuous tuft of hairs on outside of second tarsal joint, third joint scarcely wider than the fourth ..... **aldrichi**, new species.

PHROSINELLA FULVICORNIS (Coquillett)

Gymnoprosopa fulvicornis COQUILLETT, Journ. New York Ent. Soc., vol. 3, p. 106, 1895.

Hilarella fulvicornis COQUILLETT, U. S. Bur. Ent., Tech. Ser., No. 7, pp. 17, 128, 1897.—SMITH, Ins. of New Jersey, p. 782, 1909.—COLE and LOVETT, Proc. Cal. Acad. Sci., vol. 11, p. 303, 1921.—BRIMLEY, Ent. News, vol. 33, p. 23, 1922.

Euhilarella fulvicornis TOWNSEND, Proc. Biol. Soc. Wash., vol. 28, p. 22, 1915.

Phrosinella fulvicornis ALLEN, Occas. Pap. Bost. Soc. Nat. Hist., vol. 5, p. 92, 1924.

Male.—Front at narrowest 0.35 of head width (measurements of five, 0.30, 0.35, 0.35, 0.37, 0.39); front, including the vitta which is scarcely distinguishable, white or sometimes golden pollinose; vitta

divergent posteriorly, at level of lowest orbitals, three to four times width of either parafrontal; frontal row of seven to nine bristles; facial ridges with but two to three small bristles inserted directly above vibrissae; antennae red, extending about five-sixths distance to vibrassae, third joint three to four times length of second; arista thickened on basal three-fifths, penultimate joint almost twice its width; parafacials bare or sparsely beset with black bristly hairs, distinctly narrowest at the lower corner of eye; in profile, bucca equals one-sixth eye height; palpi yellow. Thorax and scutellum densely gray pollinose, without distinct vittae; intermediate pair of marginal scutellar bristles larger than the other two equal pairs; small preapicals present. Abdomen gray to golden pollinose, first segment somewhat more thinly so, with a median polished black spot, intermediate segments each with one to three triangular black spots, in third sometimes coalescing to form a continuous apical band, fourth polished black with pollinose band on basal half; one lateral and one median marginal pair of bristles on the first and the second segments, third and fourth segments with median marginal rows of about ten. Genitalia (pl. 1, fig. 6) as in *fumosa* excepting the claspers, which are smaller. Wings hyaline; often slightly clouded in middle from discal cell to costal margin; section of fourth vein beyond bend strongly arcuate, distance from bend to hind cross-vein about half length of preceding section; last section of fifth vein much less than half the preceding section. Legs black; second joint of fore tarsus bearing on ventral side a conspicuous tuft of long bristly hairs not horizontally flattened or cupped when viewed from above; last three tarsal joints much reduced in size and arched above the brush-like tuft, third segment distinctly broader than the two apical joints which are slenderly elongate; hind tibia with outside row of about nine uneven bristles.

Female.—Front at narrowest 0.44 of head width (average of fifteen which range from 0.39 to 0.45); third joint of antenna two and one-half to three and one-half times length of second. Fore tarsus (pl. 3, fig. 17) broadly flattened but not reduced in size, and lacking tuft of long bristles. Otherwise save for usual difference in genitalia, like the male.

Length, 4.0 to 7.5 mm.

Type.—Male, Cat.No. 3633, U.S.N.M., from Avalon, New Jersey, (Johnson).

These notes are based on an examination of the type and a long series of both sexes in the collections of the National Museum, Boston Society of Natural History, Museum of Comparative Zoology of Cambridge, Massachusetts, Massachusetts Agricultural College, Dr. C. W. Johnson, Nathan Banks, Prof. J. S. Hine, and the writer, including specimens from the following localities: New Hampshire;

Sunderland, West Springfield, Provincetown, Horseneck Beach, and Martha's Vineyard, Massachusetts; Avalon, Anglesea, Clementon, and Pemberton, New Jersey; Chesapeake Beach and Beltsville, Maryland; Brookland, District of Columbia; Columbus, Ohio (H. W. A.); Ira, Summit County, Ohio (J. S. Hine); Lafayette, Indiana (J. M. Aldrich), (E. W. Stafford); Michigan City, Indiana (J. M. Aldrich); Algonquin, Illinois (Nason); Great Falls, Virginia (J. M. Aldrich); Flomaton, Alabama (J. M. Aldrich); Mobile, Alabama (H. W. A.); Holly Springs, Mississippi (F. W. Mally); West Point, Mississippi (F. M. Hull); Starkville, Meridian, Agricultural and Mechanical College, Ocean Springs, Moss Point, and Gulfport, Mississippi (H. W. A.); White Springs, Florida (C. H. T. Townsend); Milwaukee, Wisconsin (S. Graenicher); Mandan, North Dakota (J. M. Aldrich); Powderville, Montana; Florissant, Colorado (S. A. Rohwer); one Brookland, District of Columbia, labeled "Parker number 50." In one specimen in C. W. Johnson's collection from Horseneck Beach, Massachusetts, the third antennal joint has a blackish cast, over yellow. This is exceptional since most specimens have bright yellow antennae. Although Coquillett states that in this species the third joint is sometimes black, I am inclined to believe, after careful study of a long series, that specimens in which this joint is black without traces of yellow belong elsewhere.

Three dried specimens of females have been dissected, and while such material is unsatisfactory, some definite information has been obtained on the nature of reproduction in this species. The uterus in each case was found filled with large naked maggots, all in the same stage of development. Fourteen were counted in one and eight in another. The larvipositor was found to consist of small, weak, nonpiercing valves located at the tip of an extensile apparatus of three segments, in repose telescoped within the abdomen.

The first instar maggot from the uterus was found to possess the following characters. The cuticula of each segment with several encircling rows of microscopic, transparent, flattened scales followed by a band of transparent, longitudinal ribs or furrows, giving to the lower part of the segment a corrugated appearance; ventral part of last segment provided with fleshy foot, densely beset with stout, sharp, brown spines; no other brown spinose areas occur. Buccopharyngeal apparatus (pl. 5, fig. 29) consists of the usual parts, in which the median hook is longer and about equal in mass to the remainder of the apparatus; the long, slender median hook tapers gradually to a strong, slender point, without denticles on the ventral surface; lateral hooks apparently fused at the tip to the median hook; ventral part of the intermediate H-piece much reduced and not barblike in profile view; upper and lower wings of the basal piece

approximated so that the height of this sclerite is distinctly less than length of its wings.

I have examined one puparium, finding the anal segment equipped with several rows of sharply pointed, microscopic spines, and the posterior spiracles located in a distinct pit (pl. 5, fig. 35) and separated by a distance equal to diameter of one spiracle.

P. fulvicornis is common in the United States east of the Mississippi River and is also known to occur in Colorado. It has been reported from Oregon, but this record will very likely be found to refer to *P. pilosifrons* or some other western species.

The adults occur on barren, sandy ditch bottoms, over sand dunes, on sand bars, barren places in open pastures, on stone-strewn country roads and on the upper marine beach. In such places they are frequently associated with several species of *Senotainia* and allied genera as well as various species of fossorial Hymenoptera. They have never been taken on flowers or rank vegetation. The adults dart about just above the surface of the ground in characteristic zigzag flight very closely resembling that of the small Larridae from which they are not readily distinguished until they alight on the ground.

One adult was captured as it emerged from the burrow of a digger wasp, presumably one of the small Bembicidae which inhabit the beach in great numbers, at Mobile, Alabama. Another specimen was reared from a puparium taken at Columbus, Ohio, where it was found in damp sand, two or three inches from the surface and in close proximity to nests of *Bembix spinolae*. The writer formed the opinion from the conditions under which the puparium was found that the maggot had come to maturity in the nest of the Bembicid and had crawled a short distance away into the loose sand to pupate, but it is by no means certain that *B. spinolae* was the host of this individual, since the tunnels of many small Larridae were present in the same sand bed in close proximity to the nests of the Bembicidae. Prof. J. B. Parker has made a very interesting observation on a fly captured on the sand where a number of different species of wasps were nesting, near Washington, D. C. (Parker note, No. 50). He says that this species has the habit of wandering about over the sand apparently engaged in smelling, and then in digging in the sand. The specimen captured dug quite a pit at the entrance of a burrow of *Oxybelus quadrinotatus* Say, and then went through the motions of oviposition in the pit. Professor Parker's observation is the first to indicate the probable use to which the strongly flattened fore tarsi of the females of North American species of *Phrosinella* have become adapted. Coquillet [35] records the rearing of an adult

[35] U. S. Bur. Ent., Tech. Ser., No. 7, p. 17, 1897.

from a puparium found among eggs of Acrididae. This association was probably accidental.

PHROSINELLA FUMOSA, new species

Male.—Front at narrowest 0.42 of head width (measurements of four 0.41, 0.42, 0.43, 0.43); front golden pollinose, including the vitta which is scarcely distinguishable from the parafrontals; vitta diverging slighlty towards the rear, at level of lowest orbitals, three times width of either parafrontal; ten to twelve bristles in the frontal row; parafrontals sparsely beset with black bristly hairs which extend downward to apex of second antennal joint, and invade the vitta to the extent of several hairs on each side between the frontal rows; facial ridges with two to four small bristly hairs not extending above the lowest fifth; antennae black, extending about seven-eighths distance to vibrissae, apex of second joint rufous, third joint four times length of second; arista thickened on basal three-fifths, length of penultimate joint one and one-half times width; parafacials white pollinose, bare, narrowest at lower corner of eye; in profile, bucca equals one-sixth eye height. Thorax densely gray pollinose with bronze reflections; two narrow vittae between the presutural dorsocentrals, ending at transverse suture; scutellum densely gray pollinose, with conspicuous black spot on each side near base; intermediate marginal bristles larger than the other two equal pairs; preapicals lacking. Abdomen densely gray pollinose, distinctly tinged with bronze; first three segments with one to three obscure spots near the apices, fourth with apical margin subshining black; first and second segments each with a single lateral and one median marginal pair of bristles; third and fourth with marginal rows of ten to twelve. Genitalia black; inner forceps elongate, tapering gradually to slender tips, somewhat flattened laterally, in profile, with a pronounced concavity on the outer margin just beyond the base, and curving slightly forward at the tips; outer forceps yellow, nearly as long and somewhat broader at the tips than inner forceps; penis with membranous hood tapering from a bulbous base to a slender erect process at the posterior apical corner, and bearing anteriorly rather coarse conical spines; posterior claspers with a small bristle. Wings subhyaline, with the area limited by small cross-vein, hind cross-vein, apex of fourth and the costal margin, infuscated; hind cross-vein and last two sections of fourth vein with clouded margins; section of fourth vein beyond bend strongly arcuate, frequently bent backward to form an acute angle with preceding section; last section of fifth vein scarcely more than one-third preceding section. Legs black; second joint of fore tarsus with a ventral tuft of long upcurved bristles, cupped when viewed from above; last three joints much reduced and arched above the tuft of bristles, the third broad and

short, the fourth and fifth slenderly elongate; hind tibia with outside row of about eight uneven bristles.

Female.—Front at narrowest 0.47 of head width (measurements of five 0.45, 0.47, 0.48, 0.48, 0.48); third antennal joint three to four times length of second. Last four joints of fore tarsus moderately flattened, not reduced, and lacking tuft of long bristles. Otherwise, except for usual differences of genitalia, like the male.

Length. 7.0 to 9.5 mm.

Type.—Male, Falls Church, Virginia, July 11, in the collection of Nathan Banks.

Allotype.—Female, Cat. No. 28157, U.S.N.M., Falls Church, Virginia, July 21 (C. T. Greene).

Described from the following: In the collection of the National Museum; one female from Massachusetts labeled "Coquillett collection"; four females from Falls Church, Virginia, July 21 (C. T. Greene). In the collection of C. W. Johnson, two females from Westport Factory, Massachusetts, July 31, 1913; one male from Delaware Water Gap, New Jersey, July 13. In J. R. Malloch's collection, one male and one female from Beltsville, Maryland, July 9, 1916. In Nathan Banks' collection, four males and four females from Falls Church, Virginia, July 4 to 25 (N. Banks), one taken feeding on honeydew on tulip tree; one male and one female, Great Falls, Virginia, June 29 and July 8 (N. Banks).

The present known range of *fumosa* is confined to the region east of the Appalachian Mountains from southern Massachusetts to eastern Virginia. In the valley of the Potomac, it has been found hovering low over stone-strewn roads through hilly upland forest, and on honeydew-coated foliage beneath the tulip tree, *Liriodendron tulipifera*. The hosts of *fumosa* are not known.

PHROSINELLA ALDRICHI, new species

Male.—Front at narrowest 0.343 of head width (measurements of three 0.33, 0.34, 0.36); front including vitta, all of face and bucca white pollinose; vitta at level of lowest orbitals four times width of either parafrontal; frontal row of eight to ten bristles, extending to middle of second antennal joint; only a few bristly hairs on front outside frontal rows; facial ridges with but one or two hairs above vibrissae; antennae black, extending five-sixths the distance to vibrissae, third joint four times length of second; arista thickened on basal three-fifths; parafacials bare, or sometimes sparsely black setulose, conspicuously narrowed at the lower corner of the eye; in profile, bucca equals one-eighth the eye height; proboscis scarcely one-half the head height; palpi subclavate, yellow. Thorax gray pollinose over black, with five obscure vittae of which the three median ones are much narrower, extending only to the transverse

suture; the intermediate pair of marginal scutellar bristles are larger than the two other equal pairs; small preapicals usually present. Abdomen black, the last three segments polished on the broad apices, white pollinose at the base, the pollinose bases indented from behind by three to five triangular spots; first and second segments each with a pair of strong median marginal bristles, the last two with uninterrupted rows of ten to twelve. Wings hyaline; section of fourth vein from bend to hind cross vein equals one-half the preceding section; last section of fifth vein nearly one-half preceding section. Legs black; fore tarsus (pl. 3, fig. 16) with its second joint enlarged and bearing a dense tuft of long bristly hairs on the outside, third and fourth joints strongly flattened, slightly longer than broad, fifth joint elongate and slender; hind tibia on outside with row of about seven uneven bristles extending from base to apex.

Female.—Front at narrowest 0.43 of head width (measurements of five 0.40, 0.41, 0.42, 0.45, 0.46); frontal vitta deeply golden pollinose, two to three times width of parafrontals at lowest orbital; third antennal joint two and one-half to three times the second. Last four joints of the fore tarsus flattened, but not reduced in size, second joint without conspicuous tuft of long hairs. Otherwise, except for usual differences in genitalia, like the male.

Length, 4.0 to 5.5 mm.

Type and allotype.—Cat. No. 28158, U.S.N.M., Lewiston, Idaho, male type collected Sept. 25, 1909; no date given for allotype.

Range.—Idaho, Nevada, California, Washington, British Columbia.

Host relationships.—Unknown.

Described from the following: two males and three females from Lewiston, Idaho; two females from Boise, Idaho; one female from Walker Lake, Nevada, July 25, 1911; one male, San Joaquin River, Newman, California. All the preceding collected by Doctor Aldrich, in whose honor the species is named; these and one male from Pasadena, California, are all in the National Museum. One female, Oliver, British Columbia, 7-vi-1923 (C. B. Garrett), in the Canadian National collection. One female, Lake Paha, Washington, 7-20-'20 (R. C. Shannon) in Shannon's collection.

PHROSINELLA PILOSIFRONS, new species

Male.—Front at narrowest 0.36 of the head width (measurements of three 0.34, 0.34 and 0.39); front, all of the face and the bucca white pollinose; vitta distinguishable as a gray pollinose band, somewhat wrinkled, moderately divergent posteriorly, at level of lowest orbitals twice as wide as either parafrontal; the single frontal row inserted at some distance from edge of vitta, and bearing thirteen to fifteen bristles; one or two bristles outside the frontal row, in the angle of divergence which it forms near base of antennae; parafrontals

thickly beset with slender erect hairs which are most dense at or below level of lowest ocellus, where they invade the vitta and form there a distinct fringe on both sides between the frontal rows; vibrissae level with front edge of oral margin; facial ridges with small bristly hairs on lowest fifth; antennae extending five-sixths the distance to vibrissae, first two joints red, third joint black, four times length of second; arista thickened on basal three-fourths, penultimate joint slightly longer than broad; parafacials hairy to near tip of antennae, distinctly narrowest at lower corner of eye; in profile, bucca equals one-sixth eye height; palpi yellow. Thorax black, subshining, sparsely gray pollinose; obscurely five-vittate, inner three vittae much narrower, none extending beyond transverse suture; notum densely pilose with fine erect black hairs; scutellum densely gray pollnose at tip, black subshining at base, the intermediate pair of marginal bristles distinctly larger than the other two equal pairs, small preapicals differentiated. Abdomen gray pollinose over black; pollinose area of first segment restricted to several small spots, intermediate segments pollinose to apices or nearly so, with three large polished black triangular spots, sometimes merging apically in the third, fourth without spots, pollinose on the basal half; first two segments each with a pair of strong median marginal bristles, third and fourth each with marginal rows of about twelve. Wings hyaline; section of fourth vein beyond bend, arcuate, but lacking an angular bend; distance from bend to hind cross-vein one-third to one-fifth the preceding section; last section of fifth vein almost half length of preceding section. Legs black; second joint of fore tarsus (pl. 3, fig. 15) bearing on the ventral side a conspicuous tuft of long bristly hairs in form of a horizontally flattened brush having its tip upcurved; last three tarsal joints much reduced in size and arched above the brushlike tuft; third segment distinctly thicker than the two apical joints which are small and elongate; hind tibia with about twelve unequal bristles in the outside row, of which one bristle near middle is much the largest.

Female.—Front at narrowest 0.45 of the head width in one specimen measured; vertex and front golden pollinose; third antennal joint two and one-half times length of second. Fore tarsus with the four apical joints flattened but not reduced in size or bearing a long tuft of hair. Otherwise, save for the usual difference in genitalia, like the male.

Length, 7.0 to 8.5 mm.

Type and allotype.—Male. Cat. No. 28159 U.S.N.M. The male type collected, Hood River, Washington, July 5, 1917 (F. R. Cole); the allotype female from Mount Constitution, Washington.

Range.—Washington, Oregon, California, British Columbia.

Host relationships.—Unknown.

Described from the following: In the collection of the National Museum; one male from Hood River, Oregon, one female from Mount Constitution, Washington, July 17, 1909 (J. M. Aldrich); one male from Pine Lake, southern California (Johnson). In the Canadian National collection; one female, Lillooet, British Columbia, 26–vii–1917 (J. D. T.), 3,000 feet; another female and one male from same locality 23–vii–1917 (J. D. Tothill) 1,500 feet; one male and one female, Victoria, British Columbia, 2–vii–1921 (W. Downes); two males labelled Pehticton, 18–vi–1918 (W. B. Anderson). In the collection of the writer one male from Hood River, Oregon.

Genus HILARELLA Rondani

Hilarella Rondani, Dipt. ital. Prodr., vol. 1, p. 70, 1856; vol. 3, p. 212, 1859. Genotype *Miltogramma zetterstedti* Rondani, which according to Bezzi and Stein, Palaark Dipt., vol. 3, p. 514, 1907 equals *hilarella* Zetterstedt.

This genus differs from all but two of the North American genera of Miltogramminae, namely *Opsidiopsis* and *Taxigramma*, in having the last section of the fifth vein distinctly more than half the length of the preceding section. It is readily distinguished from *Opsidiopsis* by the absence of a definite row of bristles on the first vein. From *Taxigramma*, to which it is morphologically very closely related, it differs in having the appendicular fold of the fourth vein shorter than the discal cell, and the last section of the fifth distinctly less than the length of the preceding section. Other generic characters are as follows: a single frontal row on either side of the vitta, descending below the base of the antennae, suddenly divergent below; proclinate ocellars present; orbital bristles in both sexes; vibrissae inserted less than length of second antennal joint above front edge of oral margin; facial ridges with bristly hairs on less than the lowest fourth; antennae extending to less than length of second antennal joint from the vibrissae; penultimate joint of arista scarcely longer than broad; in profile, the head length at the vibrissae distinctly less than at base of antennae; no pale hairs on bucca or back of head about the oral cavity; proboscis stout and much shorter than the head height; thorax with two sternopleural bristles; abdomen densely pollinose, with transverse rows of sharply defined black spots; wings with apical cell closed and ending far before the extreme tip of the wing; mesotibia with a single bristle on outer front side near the middle.

In this genus there are several European species, one of which also occurs in the North American fauna.

OTHER SPECIES OF HILARELLA MENTIONED BY COQUILLETT [36] AND ALDRICH [37]

decens Townsend, assigned to genus *Eumacronychia.*
fulvicornis Coquillett, assigned to genus *Phrosinella.*
polita Townsend, assigned to genus *Gymnoprosopa.*
siphonina Zetterstedt equals *Hilarella hilarella.*
aristalis Coquillett, assigned to genus *Oestrohilarella.*
rufiventris Coquillett, assigned to genus *Senotainia.*

HILARELLA HILARELLA (Zetterstedt)

Miltogramma hilarella ZETTERSTEDT, Dipt. Scand., vol. 3, p. 1212, 1844.
Miltogramma siphonina ZETTERSTEDT, Dipt. Scand., vol. 3, p. 1213, 1844; vol. 8, p. 3255, 1849; vol. 12, p. 4704, 1850; vol. 13, p. 6154, 1859.
Hilarella zetterstedti RONDANI, Dipt. ital. Prodr., vol. 1, p. 70, 1856; vol. 3, p. 213, 1859. Equals *hilarella,* according to Bezzi and Stein, Kat. Pal. Dipt.—SCHINER, Faun. Austr., vol. 1, p. 504, 1862.—BRAUER and BERGENSTAMM, Denkschr. Akad. Wien, vol. 51, pl. 6, fig. 133, 1889.
Miscllia siphonina ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 148, 1863.
Miscllia brunnicosa ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 148, 1863.
Heteropterina hilarella PANDELLE, Rev. entom., vol. 14, p. 312, 1895.
Hilarella siphonina COQUILLETT, U. S. Bur. Ent., Tech. Ser., No. 7, p. 129, 1897.—SMITH, Insects of New Jersey, p. 782, 1909.

Bezzi and Stein [38] place *brunnicosa* and *siphonina* in the synonymy of *dira* Robineau-Desvoidy. But *dira* equals *Miltogramma conica* Fallén, according to Robineau-Desvoidy's own statement, and *conica* belongs to *Sphecapata* equals *Senotainia,* an entirely distinct genus. I find from a study of Zetterstedt's original descriptions that *siphonina* agrees closely with *hilarella,* differing from it principally in having the segments of the abdomen marked with minute brown spots, whereas *hilarella* has transverse rows of three larger spots. An examination of the available American and European material indicates that most of the specimens have the transverse rows of three large spots, but in some specimens this character is variable. On one female in my collection, from Lafayette, Indiana, the spots on the abdomen are small, and the usual median one has been broken into two smaller ones, about the bases of the two median marginal bristles. In another specimen from Europe, labeled *Hilarella hilarella* by Professor Bezzi, the side spots are large, but as with the Indiana specimen, there are two small apical spots about the bases of the two median marginal bristles. These characters, unsupported by others, can scarcely be considered as of specific importance, hence it is my opinion that *siphonina* equals *hilarella.*

The principal characters of the species are as follows: The anterior part of the frontal vitta, the first two joints of the antennae and

[36] U. S. Bur. Ent. Tech. Ser., no. 7, p. 128, 1897.
[37] Cat. of N. A. Dipt., p. 476, 1905.
[38] Kat. Pal. Dipt., vol. 3, pp. 513–514.

usually the third, the venter and sides of the abdomen, and usually the trochanters, femora and tibiae, yellow; the lowest bristle in the frontal row much smaller than the preceding one; three proclinate and one reclinate orbital bristles; parafrontals bare of bristly hairs; parafacials black setulose; arista conspicuously plumose at middle, thickened on the basal two-fifths; thorax lacking black vittae, with three postsutural dorsocentral bristles; scutellum with three pairs of strong and nearly equal marginal bristles; each of last three abdominal segments with a transverse row of three, or sometimes four round black spots on the dorsum, and two other elongate spots on lateral angles; first segment without macrochaetae, intermediate segments with median marginal pairs; fourth with the usual marginal row; the genital segments of the male genitalia (pl. 1, fig. 3) in repose, concealed, but leaving the minute, sharply pointed, divergent, and slightly bowed prongs of the inner forceps exposed; wings hyaline, with a strong costal spine; third vein with one to three bristles near its base.

This discussion is based on the study of the following material: In the collection of the United States National Museum and Doctor Aldrich's collection, one specimen from Los Angeles County, California, two from Colorado, and one from Clementon, New Jersey (Coquillett); one from Koebler, New Mexico (W. R. Walton); one from Holly Springs, Mississippi (F. W. Mally); two from Tinajas (?) Arizona (W. J. McGee); two from White Springs, Florida (C. H. T. Townsend); one from Hot Springs, Arkansas (H. S. Barber); two from Lafayette, Indiana; seven labeled "Parker Note 45," and one labeled "Parker Note 55," from District of Columbia. In the collection of Prof. J. S. Hine, one from Germit, Pennsylvania (Harbeck), and another from Clementon, New Jersey. In the collection of Nathan Banks there are specimens collected from honeydew of tulip tree, at Falls Church, Virginia, and in that of the Museum of Comparative Zoölogy at Cambridge, Massachusetts, one specimen collected by H. E. Smith in Massachusetts. In Dr. C. W. Johnson's collection there is one specimen from Indiana. In my own collection occurs one specimen from Tupelo, one from Holly Springs, and one from McHenry, Mississippi (H. W. Allen); one from Lafayette, Indiana (E. W. Stafford); one from Agricultural and Mechanical College, Mississippi (M. R. Smith).

Range.—Massachusetts, New Jersey, Pennsylvania, District of Columbia, Virginia, Indiana, Mississippi, Arkansas, Colorado, New Mexico, Arizona, California.

The puparium has been carefully described and figured by Greene [39] who distinguishes the following characters. Walls smooth. Bottom edge nearly straight; depression in the dorsum at about the apical fifth. A deep pit at anal end, touching the horizontal bisecting plane,

[39] Proc. U. S. Nat. Mus., vol. 60, p. 12, 1921.

but largely below it. Posterior spiracles located on the upper surface of the pit, and provided with three small, straight, nearly vertical slits. Anal opening on the ventral surface of the puparium.

This species is not known to be attracted to flowers, but has been observed feeding on foliage and dry leaves smeared with honeydew.

Prof. J. B. Parker has secured some interesting notes on the biology of *Hilarella hilarella* at Washington, D. C. In one instance, on July 11, 1914 (Parker Note 45), a female of *Sphex extrematata*, var. *pictipennis* Walsh, was observed entering her burrow with a caterpillar. As she emerged a small fly alighted at the edge of the vertical opening of the burrow and deposited several maggots on the edge. These wriggled over the edge and dropped to the bottom. Three maggots were counted but there may have been more. A fly, apparently the one which deposited the maggots, was captured. The wasp, after closing the entrance, was also captured. On the following day the nest was dug up. A single caterpillar was found about an inch below the surface. No egg of the wasp was present, but four dipterous maggots were on the outside, and subsequent results indicate that four more must have been on the inside. On July 15 the maggots had completely devoured the caterpillar and had buried themselves in the sand of the breeding cell. On July 16 eight puparia were present, from which four flies issued on August 1 and three others on August 2. In another instance (Parker Note 55) a fly was captured which had persistently attempted to place its maggots on a caterpillar that *Psammophila violaceipennis* Lepeletier had captured and was dragging to her nest.

M. R. Smith has also reared the fly from the nest of *Sphex extrematata*, var. *pictipennis*, at Agricultural and Mechanical College, Mississippi. In the instance under his observation, he feels quite certain that the adult fly deposited active maggots on the paralyzed caterpillar when it was laid aside by the wasp preparatory to opening its nest. Since the caterpillar from which the flies were reared was dug up immediately after the nest had been closed by the wasp, and since with this species of wasp only one caterpillar is placed in a nest and the burrow is carefully closed both before and after depositing the prey, and as in this case the fly did not enter the burrow, apparently no other opportunity to establish its progeny was offered the fly than that furnished by the wasp in dropping its prey to open the nest. One nest containing a caterpillar of *Chloridea obsoleta* was dug up, and the following day three dipterous maggots were observed working upon it. All of them pupated, and from the puparia one adult of *Hilarella hilarella* issued.

Genus TAXIGRAMMA Perris

Taxigramma Perris, Annal. Soc. Linn. Lyon for 1850, p. 209, 1852. Genotype, *Miltogramma heteroneura* Meigen as *pipiens*, new species.—Townsend, Proc. Ent. Soc. Wash., vol. 14, p. 52, 1912.

Heteropterina Macquart, Annal. Soc. Ent. France for 1854, p. 426, 1854. Genotype, *Miltogramma heteroneura* Meigen.—Schiner, Faun. Austr., vol. 1, p. 502, 1862.—Brauer and Berganstamm, Zweifl. d. Kaiserl. Mus., vol. 56, p. 113, 1889.—Adams, in Williston's Manual of N. A. Dipt., p. 371, fig. 150, no. 62, 1908.

Elpigia Robineau-Desvoidy, Dipt. Envr. Paris, vol. 2, p. 149, 1863. The genotype, *pellucida* Robineau-Desvoidy, according to Bezzi and Stein, Kat. Pal. Dipt., equals *heteroneura* Meigen, which is also the type of *Taxigramma*.

Nasonimyia Townsend, Proc. U. S. Nat. Mus., vol. 49, p. 619, 1915. The genotype, *Heteropterina nasoni* Coquillett compared with European specimens of *heteroneura* with which it was found to be conspecific.

In 1852 Perris described as a new species *Taxigramma pipiens*.[40] The single description is for both genus and species. The distinctive characters of size, wing venation, and abdominal markings are definitely described and agree in detail with North American specimens of *Miltogramma heteroneura* Meigen described in 1830. According to Bezzi and Stein *pipiens* equals *M. heteroneura*.[41] Macquart in 1854,[42] proposed the genus *Heteropterina* for which *heteroneura* became the genotype. But since *Taxigramma* was proposed for *pipiens* which equals *heteroneura*, the genotype, some years before *Heteropterina*, it appears that the former should replace *Heteropterina* as the name of the genus. Coquillett[43] pointed out this synonymy in 1910, but for some undetermined reason it has not been generally accepted.

The outstanding character of this genus is the unusual degree to which the wing venation is crowded toward the costa. From the other North American genera of *Miltogramminae*, it is readily separated by the extreme length of the appendicular fold of the fourth vein and the last section of the fifth vein. The fold is distinctly longer than the discal cell, and the last section of the fifth vein longer than the preceding section. Other generic characters are as follows: A single frontal row on either side of the vitta, descending below base of second antennal joint, suddenly divergent below; proclinate ocellar bristles present, and orbitals occur in both sexes; vibrissae inserted near oral margin; facial ridges bristly on less than lowest fourth; lunule conspicuously exposed; antennae extend to less than length of the second joint from vibrissae; penultimate joint of arista scarcely longer than broad; in profile, head length at vibrissae less than at base of antennae; proboscis stout, scarcely as long as head height;

[40] Soc. Linn. Lyon, 1852, p. 65.
[41] Kat. Pal. Dipt., vol. 3, p. 517, 1907.
[42] Annal. Soc. Entom. France for 1854, p. 426.
[43] Proc. U. S. Nat. Mus., vol. 37, p. 551, 1910.

abdomen densely pollinose, with transverse rows of small, sharply defined, black spots; apical cell closed at margin of wing.

The genus is represented by several European species, one of which is also widely distributed over North America.

TAXIGRAMMA HETERONEURA (Meigen)

Miltogramma heteroneura MEIGEN, Syst. Beschr., vol. 6, p. 367, 1830.—ZETTERSTEDT, Dipt. Scand., vol. 3, p. 1214, 1844.

Taxigramma pipiens PERRIS, Annal. Soc. Linn. Lyons, for 1850, p. 209, 1852.

Heteropterina heteroneura MACQUART, Annal. Soc. Ent. France, vol. 7, p. 427, 1854.—SCHINER, Faun. Austr., vol. 1, p. 503, 1862.—PANDELLE, Rev. Ent., vol. 14, p. 313, 1895.—VILLENEUVE, Bull. Soc. Ent. France, for 1900, p. 381.

Elpigia pellucida ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 150, 1863.

Elpigia punctata ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 150, 1863.

Elpigia minuta ROBINEAU-DESVOIDY, Dipt. Envr. Paris, vol. 2, p. 151, 1863.

Heteropterina nasoni COQUILLETT, Ent. News, vol. 6, p. 207, 1895; U. S. Bur. Ent., Tech. Ser., No. 7, p. 76, 1897.—WALTON, Proc. U. S. Nat. Mus., vol. 48, p. 181, 1914.—REINHARD, Ent. News, vol. 30, p. 281, 1919.—COLE and LOVETT, Proc. Cal. Acad. Sci., vol. 11, p. 301, 1921.

A single female specimen from Hungary, determined as *heteroneura* by Prof. Karl Sajo, I have compared with North American specimens of *nasoni* Coquillett, and another European specimen determined as *heteroneura* by Kertesz, with the type of *nasoni*, and it is my conviction that the European and North American forms are conspecific. In the synonomy of the three species of *Elpigia* proposed by Robineau-Desvoidy, I have followed Bezzi and Stein.[44] The type of (*Heteropterina nasoni*) Coquillett is located in the United States National Museum, the location of the other types not known to the writer.

The frontal vitta, antennae, palpi, abdomen, femora, and tibia largely yellowish. Front at narrowest measuring 0.34, 0.34, 0.34, 0.34, 0.36, averaging 0.34 of the head width in five males; 0.35, 0.36, 0.38, 0.40, 0.40, averaging 0.38 in five females; frontal vitta at level of lowest orbitals one-half to one-third as wide as either parafrontal; two proclinate orbital bristles present; the lowest bristle of the frontal row much weaker than the others; third antennal joint one and one-half to two times as long as the second; arista thickened on basal third; parafacials bare or with microscopic black hairs. Thorax densely pollinose, without black vittae; scutellum bears three pairs of marginal bristles of which the intermediate pair is much the strongest. The last three abdominal segments each with a transverse row of three small round black spots on the dorsum, and two other elongate spots on the lateral angles; first segment usually,

[44] Kat. Pal. Dipt., vol. 3, p. 517, 1907.

the intermediate always, with a pair of strong median marginal macrochaetae, fourth with a marginal row. Wing with one or two strong costal spines; third vein bristly at least half way to small cross vein.

Length 3.5 to 6.0 mm.

These notes are based on the study of the following material: A long series of both sexes in the National Museum, including one European specimen determined by Kertesz; one male from Algonquin, Illinois, type for (*nasoni*); one from Lafayette, Indiana, two from Mandan, North Dakota, two from Bottineau, North Dakota, one from Boise and another from Lewiston, Idaho (J. M. Aldrich); three from Beach, North Dakota, labeled "taken from sunflower, Webster No. 23302" (C. N. Ainslie); one from South Dakota; three from Colorado (Coquillett); one from Wild Horse Canyon, Animas Mountains, New Mexico, 5,000 feet; one from Soroco, New Mexico (Williston); two from Koehler, New Mexico, Webster No. 7707 (W. R. Walton); one from Ormsby County, Nevada (Baker); two from Kaslo, British Columbia (A. N. Caudell); Waubamic, Parry Sound, Ontario. In the Museum of Comparative Zoölogy at Cambridge, Massachusetts; one female from Hungary, determined by Prof. Karl Sajo, and specimens from Milwaukee, Wisconsin (G. Graenicher), and Massachusetts (H. E. Smith).

Range.—Massachusetts, Indiana, Illinois, Wisconsin, North Dakota, South Dakota, Colorado, New Mexico, Texas, California, Nevada, Utah, Idaho, Oregon, British Columbia, and Ontario. It is also, according to Bezzi and Stein, widely distributed over Europe.

Host relationships.—Reared from grasshopper by C. N. Ainslie at Payson, Utah.[45] This is an unusual record for a Miltogramminid. It is questionable whether this fly will prove to be normally parasitic on the active stages of grasshoppers or other herbaceous insects.

Reinhard [46] has noted the species as being persistently present in Texas during May, June, and July. Several specimens were taken in the insectary and others from sweeping grass and foliage near the ground.

Genus EUMACRONYCHIA Townsend

Eumacronychia Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 98, 1892, genotype *decens* in the University of Kansas Museum; Trans. Amer. Ent. Soc., vol. 22, p. 74, 1895; Smithson. Misc. Coll., vol. 51, p. 64, 1908.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 128, 1897; Proc. U. S. Nat. Mus., vol. 37, p. 541, 1910 (equals *Hilarella*).

This genus, erected by Townsend in 1892, has long been considered synonymous with *Hilarella* and has never been generally accepted. After a careful study of available material, including genotype speci-

[45] Walton, Proc. U. S. Nat. Mus., vol. 48, p. 181, 1914. [46] Ent. News, vol. 30, p. 281, 1919.

mens of *Hilarella*, and *decens*, the type of *Eumacronychia*, I am convinced that the latter is generically distinct. The species of *Eumacronychia* as a whole possess almost the same combination of characters as those of *Gymnoprosopa*, and certain species such as *clita* and *rohweri* possess striking resemblances to both genera, but the male genitalia in *Eumacronychia* are uniformly large and highly specialized, somewhat resembling those of typical Sarcophaginae, while the male genitalia of *Gymnoprosopa* are small and relatively unspecialized as in *Metopia* and related genera. In *Eumacronychia*, the female genital segments extrude conspicuously, the apical scutellar bristles are absent or if present are much smaller than either pair of lateral marginals, the front is usually distinctly narrower near base of the antennae than towards the vertex, and the male usually possesses conspicuously long broad pulvilli, and a tendency toward villosity on the legs, all characters distinguishing it from *Gymnoprosopa*. Other characters of the genus are as follows:

Inner orbits not sinuous or pinched in at the level of vibrissae; frontal vitta light red or yellow, at least as wide as the parafrontal, diverging moderately toward the vertex; lunule scarcely visible; a single frontal row of bristles terminating at base of antennae, not suddenly divergent below; proclinate ocellar bristles present; orbitals in both sexes; antennae distinctly more than half as long as the face; penultimate joint of the arista short; vibrissae not more than the length of second antennal joint above front edge of oral margin; in profile, head length at vibrissae sometimes subequal, usually much less than at base of antennae; lower part of bucca with sparse black bristly hairs; no pale hairs about the oral cavity; proboscis moderately stout, shorter than the head height, with fleshy labella and normal palpi. Thorax with three strong postsutural dorsocentral bristles and two sternopleurals. Pollen on the intermediate segments of the abdomen arranged in basal bands which are not scalloped or indented on the apical margin; abdomen never marked with large black spots. Wing with apical cell open; only the third vein bristly; last section of fifth vein less than half the length of the preceding section. Joints of the fore tarsus not ornamented, conspicuously reduced in size, flattened, or otherwise modified from the normal in either sex; pulvilli of male variable in length.

None of the species of this genus are known at present from outside the continental North American area. I have seen very few specimens from north of the latitude of New Jersey. The genus is composed of several species of attenuated or possibly discontinuous distribution. Not one of the species is definitely known to have a transcontinental range except *sternalis* identified from Galveston, Texas, and Granada, Nicaragua. The Southwest appears to be the center of distribution of the group. Nothing is known concerning

the host relationships and scarcely more concerning the habits of the species in this genus.

KEY TO NORTH AMERICAN SPECIES OF EUMACRONYCHIA

1. Fourth abdominal segment wholly black ..... 5.
   Fourth abdominal segment red, at least on its apex ..... 2.
2. Parafacials at most with sparse black bristly hairs on the lower half of face; third antennal joint bright red or yellow; claws of inner forceps of male genitalia widely divergent ..... 3.
   Parafacials on upper half, thickly beset with black bristly hairs; third joint of antennae black; claws of inner forceps of male genitalia not divergent. **nigricornis**, new species.
3. Arista thickened on basal three-fifths; inner orbits divergent from base of antennae to vertex; fourth sternite of male ordinary ..... 4.
   Arista thickened on basal two-fifths; inner frontal orbits parallel; in male the fourth sternite is conspicuously exposed and covered with short erect villosity, and the prongs of inner forceps are not bowed in the middle, pulvilli longer than the last two tarsal joints; in female, first genital segment appearing like a fifth abdominal segment, not arched like an inverted V, but broadly rounded above ..... **sternalis**, new species.
4. Bucca in profile equals one-half eye height; facial depression scarcely wider than either parafacial; in male, pulvilli longer than the last two tarsal joints, prongs of inner forceps strongly bowed in middle when viewed from behind, apical flexor surface of middle tibia with long, erect villosity; in female, first genital segment resembles a fifth abdominal segment and is arched above like an inverted V ..... **decens** Townsend.
   Bucca in profile equals one-fifth eye height; facial depression twice width of either parafacial; in male, pulvilli shorter than last two tarsal joints, prongs of inner forceps when viewed from behind are not bowed in middle; middle tibia without erect villosity ..... **montana**, new species.
5. Parafacials distinctly hairy; arista thickened on basal two-fifths; palpi and third antennal joint black ..... 6.
   Parafacials bare; arista thickened on basal three-fifths; palpi yellow. **elita** Townsend.
6. Intermediate abdominal segments with sharply defined pollinose bands on basal two-thirds; buccal width less than one-third eye height. **rohweri**, new species.
   Intermediate abdominal segments densely pollinose to apices; buccal width exceeds one-third the eye height ..... **elongata**, new species.

EUMACRONYCHIA DECENS Townsend

Eumacronychia decens Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 99, 1892; vol. 22, p. 74, 1895.

Hilarella decens Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 128, 1897.—Smith, Ins. of New Jersey, p. 782, 1909.

Male.—Front at narrowest point, which is just above the base of the antennae, 0.35 of head width (measurements of three as follows: 0.33, 0.34, 0.37); frontal vitta at level of lowest orbitals one and one-half times width of either parafrontal; frontal row with about ten bristles; one reclinate and three proclinate orbital bristles; parafrontals with a few short bristly hairs near the vertex; facial depression scarcely wider than either side of face; vibrissae inserted nearly

length of second antennal joint above front edge of oral margin, and approximated to distance nearly twice its length; facial ridges with but two or three small hairs above the vibrissae; antennae yellow, third joint four times length of second; arista thickened on basal three-fifths; in profile, bucca wider than parafacials and equals one-half eye height; front projects nearly one-half eye height; head length at vibrissae slightly less than at base of antennae; parafacials with microscopic white pile; palpi yellow. Thorax densely gray pollinose, with one to three narrow median and two broader lateral vittae; apical scutellar bristles much smaller than the other two marginal pairs; small preapicals present. Abdomen black excepting the fourth segment which is broadly yellow; last three segments with dense white pollinose bands on basal half; second segment with a median marginal pair of bristles; third and fourth segments with marginal rows of from six to ten; venter densely villous, fourth segment not conspicuous. Genital segments yellow, first segment bare, second with very short bristly hairs; inner forceps curved slightly forward, tapering gradually to sharp, black tips; when viewed from the rear, the prongs are separated and strongly bowed at the middle Wing hyaline, bearing a small costal spine; third vein bristly about half way to small cross-vein; hind cross-vein parallel to section of fourth vein beyond the bend. Legs black, with conspicuous claws and pulvilli which are longer than the last two tarsal joints on all the feet; middle tibia with one bristle on outer front side near the middle, on apical half of flexor side with distinct, villous, suberect hair, in best view, as long as width of tibia; hind femur moderately villous; hind tibia with three uneven bristles on outer surface before the middle; on flexor surface with rather long appressed hair.

Female.—Several specimens which most closely resemble the male have the following characters. Front at narrowest point 0.40 of the head width (measurements of four as follows: 0.40, 0.40, 0.40, 0.41); third antennal joint three to four times as long as the second; in profile, bucca scarcely one-third eye height. Second abdominal segment lacking macrochaetae, third segment with very weak marginals outside the median pair. First genital segment large, fully exposed, simulating a fifth abdominal segment, with a sharply pointed, inverted V-shaped arch above, drawn together at the sides. Femora and tibiae without villosity. Otherwise save for the usual differences of genitalia, like the male.

Length, 5.5 to 8.5 mm.

Host relationships.—Unknown.

This species was originally described from four males and nine females, all apparently cotypes. The type series which was deposited in the University of Kansas Museum has dwindled to three, of which one fortunately is a male. This material was loaned to the National

Museum and carefully examined and compared with other material by Dr. J. M. Aldrich, upon whose examination this redescription is based. Other material examined is as follows: One male from Los Angeles County, California, August; one male, Socorro, New Mexico, 1916 (Williston); one female from Hot Springs, Arkansas (H. S. Barber); one female from Wild Horse Canyon, Animas Mountains, New Mexico, 5,000 feet; one female, Yuma, Arizona, June 25, 1917 (J. M. Aldrich); one female from Fort Grant, Arizona (H. G. Hubbard); two females from Los Angeles County, California, July; all in the collection of the National Museum. One female in the collection of Prof. J. S. Hine, collected at College Station, Texas. The male in the University of Kansas Museum, labeled "Las Cruces, N. M. 7–7," designated as type.

There are now known to be several very closely related species resembling *decens* in the southwestern part of the United States. While the males possess outstanding characters, the females I have examined have proved more difficult and have been somewhat uncertainly placed. Females agreeing with the males of *decens* in the appearance of the arista, the degree of approximation of the vibrissae, and in having the front narrowest just above the base of the antennae have been assigned to this species.

EUMACRONYCHIA MONTANA, new species

Male very closely resembles *E. decens* from which it differs in the following characters: Front at narrowest, 0.29 of the head width in one specimen measured; frontal vitta densely pollinose over the yellow; frontal row of about seven weak bristles; one reclinate and two proclinate orbital bristles present; facial depression twice the width of parafacial; length of third joint of antenna three times the second; vibrissae inserted at one-half the length of second antennal joint above front edge of oral margin; in profile, bucca subequal to parafacial, equal to one-fifth eye height; parafacial bare. Prongs of inner forceps of genitalia divergent, but not bowed when viewed from the rear; outer forceps tapering to points more slender than those of inner pair, broadly curved towards tips of latter. Wings without costal spine. Pulvilli as long as last tarsal joint; tibia without long villous hairs. Female not known.

Type.—Male. Cat. No. 28160, U.S.N.M. Mesilla Park, New Mexico.

Described from one male from Mesilla Park, New Mexico (C. N. Ainslie), in the collection of the National Museum; and one male from Mount Superstition, near Higley, Arizona, July 26, 1917, on *Agave palmeri* (E. G. Holt), loaned by J. R. Malloch.

EUMACRONYCHIA STERNALIS, new species

Very closely resembles *E. decens*, from which it differs in the following characters:

Male.—Front 0.385 of the head width (measurements of two 0.38 and 0.39, respectively); inner orbits parallel from vertex to base of antennae; frontal vitta at level of lowest orbitals twice as wide as either parafrontal; one reclinate and two proclinate orbital bristles; vibrissae strongly approximated, to a distance scarcely exceeding length of second antennal joint; third joint of antenna three times length of second; arista thickened on basal two-fifths. Abdomen black, at least the apex of fourth segment reddish; fourth sternite conspicuously exposed and covered with short dense black villous hairs. Inner forceps of the genitalia, when viewed from behind, not bowed in the middle; outer forceps about as stout as the inner pair, grooved behind, broadly curved toward tip of inner forceps but pointed toward penis at the extreme tip. Villosity on apical flexor surface of middle tibia as long as half the width of tibia; hind tibia with only ordinary black appressed hair.

Female.—I have examined several specimens which resemble the male in having the inner orbits nearly parallel and the vibrissae closely approximated and which are evidently conspecific with it. They also very closely resemble the female described for *E. decens*, from which they may be distinguished by the following characters: Front slightly wider, averaging 0.415 in four specimens measuring 0.41, 0.41, 0.42, and 0.42, respectively. The first genital segment simulates a fifth abdominal segment, with marginal macrochaetae, but is not arched in an inverted V-shape manner.

Length, 5.0 to 9.0 mm.

Type.—Male. Cat. No. U.S.N.M. 28161, Galveston, Texas.

Host relationships.—Unknown.

Described from one male from Galveston, Texas, VIII–28–1914, Bishopp No. 3516 (F. C. Bishopp); one male from Granada, Nicaragua (Baker); one female from Las Cruces, New Mexico, July 7, marked "type" and evidently one of Townsend's cotypes of *E. decens* incorrectly identified; one female from San Jose de Cabo, southern California (Townsend); one female from Los Angeles County, California, September; all in the collection of the National Museum. One female from Brewster County, Texas, June 13–17, 1908 (Mitchell and Cushman) occurs in the Museum of Comparative Zoology of Cambridge, Massachusetts; and one female from San Jose, Guatemala, February 5, 1905, was seen in the collection of Prof. J. S. Hine.

EUMACRONYCHIA NIGRICORNIS, new species

Male.—Front at narrowest 0.24 of the head width (in the single specimen examined the front appears somewhat crushed in and therefore may be narrower than normal); face and front yellow, overlaid with silvery pollen; inner orbits most nearly approximated at base of antennae, diverging moderately toward vertex; frontal vitta pale-yellow, with sides slightly convergent to before middle, thence moderately divergent to vertex, at level of lowest orbital one and one-half times width of either parafrontal; nine bristles in frontal row which extends downward as far as base of second antennal joint; one reclinate and two proclinate orbital bristles present; parafrontals with long, erect, black, bristly hairs continuous down over parafacials to lower end of eye; vibrissae separated by a distance nearly twice the length, and inserted one half the length, of the second antennal joint above front edge of oral margin; facial ridges with one or two small bristly hairs above vibrissae; antennae with second joint red, third joint black or at most with dense black tomentum over red, three times length of second; arista thickened on basal three-fifths; in profile, buccal width greatly exceeds that of the parafacials and equals one-third the eye height, head length at vibrissae much less than at base of antennae, front projects about one-half the horizontal diameter of the eye; palpi pale yellow, slightly clavate. Thorax gray pollinose, marked with three broad black vittae which are continuous to the scutellum; three postsutural dorsocentral bristles present; scutellum with two pairs of strong marginal bristles, a pair of minute decussate apicals, and another pair of small preapicals. Abdomen black, save the apex of the fourth segment, which is red; basal two-thirds of last three segments gray pollinose with bronzed reflections; apices of the intermediate segments and a broad median dorsal vitta, polished black; first segment with a single lateral bristle; second with one lateral and one strong median marginal pair; third and fourth each with an uninterrupted marginal row of eight to ten bristles; venter clothed with long erect villosity, the length of which exceeds the diameter of the hind femur. Genital segments large, pale yellow, lacking macrochaetae; first segment bare, second clothed with minute black, bristly hairs; inner forceps with black tips, in profile straight nearly to apex, thence curved abruptly forward, claws not divergent; outer forceps less massive and slightly shorter than the inner pair, tapering rapidly to just before the black tips, thence expanding in a small angular head, apposed to the tips of the inner forceps; anterior claspers large, black, sickle-shaped; penis supported by usual heavily chitinized rod terminating in a ring, from the center of which arises a posteriorly directed, bottle-shaped, membranous hood. Wings hyaline; fourth vein with a right-angular bend; section beyond the bend nearly parallel to the hind cross vein; costal

spine minute; third vein with a row of small bristles extending more than half-way to the small cross vein. Legs black; pulvilli of the forefeet as long as, of the other feet, slightly shorter than, the last two tarsal joints; inner proximal surface of femora with fine erect villosity, in length nearly equal to greatest diameter of femur; middle tibia with one bristle on outer front side near the middle, and with dense erect villosity on inner distal surface equaling diameter of tibia; hind tibia on outside with row of four or five unequal bristles, of which the distal one is much the largest and is inserted just beyond the middle.

Female.—Front at narrowest 0.39 of head width in the single specimen measured; frontal vitta with its sides parallel. Abdomen without macrochaetae on the first segment, a minute pair of median marginals on the second, one lateral and one pair of strong median marginals on the third; venter of abdomen and legs without long erect villosity. The first genital segment simulating a fifth abdominal segment, broadly rounded above, and enclosing two elongate valves which meet in a long slit on the longitudinal-vertical bisecting plane. Pulvilli one-half length of last tarsal joint.

Length, 5.5 to 8.0 mm.

Type.—Male. Sugar Grove, Ohio, May 19 (J. S. Hine).

Allotype.—Female. Sugar Grove, Ohio, May 19 (J. S. Hine).

Described from two specimens in the collection of Prof. Hine.

Host relationships.—Unknown.

EUMACRONYCHIA ELITA Townsend

Eumacronychia elita TOWNSEND, Trans. Amer. Ent. Soc., vol. 19, p. 100, 1892; vol. 22, p. 74, 1895.

Hilarella elita COQUILLETT, U. S. Bur. Ent., Tech. Ser., No. 7, p. 129, 1897.

Senotainia fasciata COQUILLETT, U. S. Bur. Ent. Tech. Ser., No. 7, p. 81, 1897.

Male.—Front at narrowest 0.34 of the head width (measurements of two being 0.32 and 0.36 respectively); vitta yellow, when viewed from the front, whitish pollinose, narrower than parafrontal at base of antennae, but gradually widening to three times width of parafrontal at ocellar triangle; parafrontals silvery, destitute of bristly hairs; about six bristles in frontal row; parafacials, facial depression and bucca silvery white; vibrissae inserted slightly more than half length of second antennal joint above front edge of oral margin; antennae extend four-fifths distance to vibrissae, second joint red, third joint yellow with dark reflections or black, the anterior apical margin sharply angulate, length one and one-half to two and one-half times second; arista thickened on basal three-fifths; parafacials bare; in profile, buccal width equals one-third eye height, length of head at vibrissae slightly less than at base of antennae, epistoma not protruding; proboscis almost as long as head; palpi yellow and dis-

tinctly clavate. Thorax densely gray pollinose, with two obscure vittae; scutellum with two pairs of strong marginal bristles, apical pair lacking. Abdomen black; segments shining on apices; basal halves of last three with broad white pollinose bands sharply defined from the black and not extending over the venter, first abdominal segment with one lateral and one weak median marginal pair of bristles, second with one lateral and one strong median marginal pair, the last two with marginal rows of about eight, the marginal bristles of the third as strong as those of the fourth segment. Genitalia large, black, in repose prominently extruding from tip of abdomen, exposed for distance about two-thirds the length of the fourth abdominal segment; second genital segment distinctly longer than first. Wings hyaline; posterior cross vein parallel with the nearly straight section of the fourth vein beyond the bend; last section of fifth vein equals one-third the preceding section; costa with a small spine; third vein with a row of small bristles reaching more than half way to small cross vein. Legs black; pulvilli of fore feet nearly one and one-half times length of last tarsal joint; one small bristle on outer front side of middle tibia near its middle; hind tibia with two unequal bristles on outside surface before the middle.

Female.—Not known.

Length, 3.0 to 5.0 mm.

Host relationship.—Unknown.

Redescribed from the type, which is a male from Las Cruces, New Mexico, August 7, and another male from the same locality, September 17, which is Coquillett's type for *Senotainia fasciata*, both in the National Museum.

EUMACRONYCHIA ROHWERI, new species

Male.—Front in the single specimen measured 0.31 of the head width; frontal vitta yellow, with parallel sides on anterior half, moderately divergent posteriorly, at level of lowest orbitals slightly more than twice as wide as the parafrontal; vertex gray pollinose; parafrontals, whole of face and bucca white pollinose; seven to nine bristles in the frontal row; one reclinate and two proclinate orbital bristles; a few black bristly hairs on the parafrontals outside the frontal rows; vibrissae less than one-half length of second antennal joint above front edge of oral margin; facial ridges with but one or two small bristly hairs just above vibrissae; antennae extend four-fifths distance to vibrissae, second joint brown, third joint black with its length two and one-half times the second and the outer apical angle bluntly pointed; arista thickened on basal two-fifths; parafacials sparsely covered with black bristly hairs; in profile, buccal width nearly equals one-third eye height; proboscis distinctly shorter than height of head; palpi clavate, black. Thorax gray pollinose, merging

with brown on the notum, with three to five obscure black vittae; scutellum with two pairs of strong marginal bristles, apicals lacking, one pair of weak preapicals. Abdomen black, the last three segments each with a sharply defined, white pollinose band on the basal two-thirds, prolonged ventrally to the sternum; first two adbominal segments each with two or more weak laterals and a strong median pair of marginal bristles, third and fourth with uninterrupted marginal rows. Genitalia in repose, prominent, extruding from fourth abdominal segment for distance equal to their length; genital segments shining black, first smaller than the second; fifth sternite conspicuous, armed posteriorly with a tuft of stubby spines, laterally with slender bristles. Wings hyaline; fourth vein beyond the bend slightly arcuate and parallel with the hind cross vein; section from bend to hind cross vein about one-half as long as preceding section; last section of fifth vein about one-fourth as long as preceding section; one small costal spine; third vein with row of small bristles extending approximately half way to small cross vein. Legs black; pulvilli of fore feet one and one-fourth times as long as last tarsal joint; middle tibia with one bristle on outer front side beyond the middle; hind tibia on outside with row of four unequal bristles terminating in the strongest, slightly beyond the middle.

Female.—Not known.

Length, 6.5 mm.

Type.—Male, Cat. No. 2811, U.S.N.M.

Host relationships.—Unknown.

Described from a single male, Florissant, Colorado, June 28, 1908, (S. A. Rohwer) in the National Museum labeled "rohweri."

EUMACRONYCHIA ELONGATA, new species

Male.—Front 0.365 of the head width (in two specimens measured 0.36 and 0.37 respectively); front including the vitta, face, and bucca, densely white pollinose, merging with gray pollen at vertex; vitta with parallel sides to middle thence moderately divergent to vertex, at level of lowest orbitals twice width of parafrontal; frontal row of about six weak bristles extending to base of antennae; one reclinate and two proclinate orbital bristles; parafrontals almost destitute of bristly hairs; vibrissae inserted one-half second antennal joint above front edge of oral margin; one or two small bristles above vibrissae on facial ridges; first two antennal joints brown, third black and two and one-half times length of second; arista thickened on basal two-fifths; parafacials moderately black setulose; in profile, bucca wider than parafacials at their narrowest and nearly one-half eye height, front projects more than half the horizontal diameter of eye; proboscis slightly shorter than head height; palpi black, distinctly flattened and enlarged at the tip, subfoliaceous. Thorax gray pollinose with two

narrow obscure vittae near median line, and clothed with short suberect hair; scutellum with two pairs of marginals of which the lateral pair is distinctly smaller. Abdomen long and slender, black, densely overlaid with grayish, bronze-tinged pollen to apices of all the segments; first three segments each with a strong median marginal pair of bristles and two to three strong laterals, fourth with the usual uninterrupted marginal row. Male genitalia prominent, in repose, extruding from tip of abdomen for distance equal to length of last abdominal segment; first segment subshining black with subapical row of about four bristles; second segment dull reddish, sparsely pollinose, moderately beset with fine black hairs; inner forceps black, much less massive than outer pair, about three times longer than greatest width, tapering abruptly to beyond middle, thence gradually to weak, slender, slightly curved tips, united to beyond middle, tips separated by linear cleft; outer forceps yellow at base, tapering abruptly to near tips, thence expanded into large, polished black, laterally compressed, lanceolate points, when viewed from rear the forceps display an inwardly directed angle near the base beyond which they are strongly bowed; penis slender, black, strongly chitinized to tip, hood in profile triangular with a minute membranous process at posterior angle and a spiniferous pit between the posterior and apical angles; posterior claspers large and bearing a prominent bristle, anterior clasper vestigial; fifth sternite much enlarged and heavily chitinized, punctate, with a broad U-shaped cleft fringed with a row of long hairs terminating at the lateral angle which is produced as a strong black tooth; fourth sternite closing the genital cavity anteriorly and bearing ventrally near the apex, two small combs of short black bristles. Wings hyaline; small costal spine present; third vein bristly about one-half way to small cross vein. Legs black; pulvilli of fore feet as long as last two tarsal joints; middle tibia with usual bristle on outer front side near middle; hind tibia on outside with three unequal bristles of which the most distal, located slightly beyond the middle, is the largest.

Female.—Not known.

Length, 7.0 mm.

Type.—Male, in the Canadian National Collection from Onah, Manitoba, 21–VI–1921 (P. Vroom).

Host relationships.—Unknown.

Described from the type, and one other male specimen, Glenboro, Manitoba, 7–VI–1920 (H. A. Robertson), in the Canadian National Collection.

Genus GYMNOPROSOPA Townsend

Gymnoprosopa Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 108, 1892, type, *polita;* Smithson. Misc. Coll., vol. 51, p. 64, 1908.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 128, 1897; Proc. U. S. Nat. Mus. vol. 37, p. 548, 1910 (*Hilarella*).

This genus also, has long been considered synonymous with *Hilarella*. Genotype specimens of *Hilarella* and *Gymnoprosopa* posesss rather striking differences in the conformation of the head and in the distribution of pollen on the abdomen, which are linked with certain minor variations, constant among the species of the respective groups, and should certainly be considered distinct genera. From the more nearly related genus *Eumacronychia*, *Gymnoprosopa* differs in having the male genitalia minute, not highly specialized, in repose, largely concealed within the tip of the abdomen, while the female genitalia are small and inconspicuous. These characters associated with smallness, the presence of three pairs of marginal scutellar bristles of which the apical pair is at least as strong as the extreme laterals, and the contour of the inner orbits which are not more nearly approximated near base of antennae than at the vertex, readily distinguish *Gymnoprosopa* from *Eumacronychia*. Other characters of the genus are as follows:

Inner orbits not pinched in at level of vibrissae; frontal vitta light red or yellow, at least as wide as the parafrontal; lunule scarcely visible; a single frontal row of bristles terminating at base of antennae, not suddenly divergent below; proclinate ocellar bristles present; orbitals in both sexes; antennae distinctly more than half as long as the face; penultimate joint of arista short; vibrissae distinctly less than length of second antennal joint above front edge of oral margin; in profile, head length at vibrissae sometimes subequal, usually much less than at base of antennae; lower part of bucca with sparse black bristly hairs; no pale hairs about the oral cavity; proboscis moderately stout, shorter than the head height, with fleshy labella and normal palpi. Thorax with three strong postsutural dorsocentral bristles and two sternopleurals. Pollen on intermediate segments of abdomen arranged in basal bands which are not scalloped or indented on the apical margin; abdomen never marked with large black spots. Wing with the apical cell open; only the third vein bristly, last section of fifth vein less than half the length of preceding section. Joint of fore tarsus not ornamented, conspicuously reduced in size, flattened, or otherwise modified from the normal in either sex; pulvilli of male variable in length.

None of the species of this genus are known to occur outside the continental North American area, and I have as yet seen no specimens from north of the continental United States. The genus is

composed of several species of attenuated or possibly discontinuous distribution. Not one of the species is definitely known to have a transcontinental range, and specimens from west of the Mississippi River are not frequently seen in collections. Possibly *polita* has the widest range, being recorded from Ithaca, New York, to the Animas Mountains, New Mexico, and Florida. Very little is known of the ecology of any of the species of this genus. Scattered information indicates that they frequent low foliage and may be attracted to flowers. Nathan Banks writes that the adults of some species are found feeding frequently on honeydew falling from the tulip tree, *Liriodendron tulipifera*, in Virginia, and W. L. McAtee has collected another species on the flowers of *Ceanothus americanus*. Nothing is known of the host relationships in this group.

KEY TO NORTH AMERICAN SPECIES OF GYMNOPROSOPA

1. Parafacials with black bristly hairs ..... 4.
   Parafacials bare, or at most with minute, scarcely visible hairs ..... 2.
2. Last three segments of abdomen pollinose on basal half, the pollinose bands thickly beset with black bristly hairs; extreme lateral pair of scutellar bristles as strong as the apicals; preapicals present ..... 3.
   Last three segments of abdomen pollinose on basal third of segment; pollinose bands almost free of bristly hairs; bristles of third abdominal segment as strong as those of fourth; extreme lateral pair of scutellar bristles weaker than apical pair; preapicals lacking; front pulvilli of male less than half as long as last tarsal joint ..... **polita** Townsend.
3. Frontal vitta pale yellow; third vein with one small bristle near its base; hind cross vein nearly parallel to section of fourth vein beyond the bend; front pulvilli of male one-fourth as long as last tarsal joint; first and second abdominal segments with red on sides ..... **pallida**, new species.
   Frontal vitta dark yellow to red; third vein with two or three bristles at its base; hind cross vein not parallel to section of fourth vein beyond the bend but perpendicular to preceding section; front pulvilli of male as long as last tarsal joint; first and second abdominal segments without red on the sides **argentifrons** Townsend.
4. With three or four proclinate orbital bristles; palpi clavate; third antennal joint conspicuously inflated; second and third abdominal segments pollinose on basal half ..... **inflaticornis**, new species.
   With only two proclinate orbital bristles; palpi filiform; third antennal joint not inflated; second and third abdominal segments pollinose on basal third. **filipalpus**, new species.

GYMNOPROSOPA POLITA Townsend

Gymnoprosopa polita Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 109, 1892.

Gymnoprosopa clarifrons Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 109, 1892.

Hilarella polita Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 128, 1897.—Aldrich, Cat. of N. A. Diptera, p. 447, 1905.—Smith, Ins. of New Jersey, p. 782, 1909.—Johnson, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 73, 1913.

After reexamining types of *polita*, *argentifrons*, and *clarifrons* together with a fairly long series of specimens not previously available

to Coquillett or Aldrich, it becomes evident that *polita* and *clarifrons* are synonymous, but that *argentifrons*, considered synonymous with *polita* by the above, is clearly a distinct species.

Female.—Front at narrowest 0.43 of head width (measurements of four 0.40, 0.42, 0.44, and 0.45, respectively), noticeably flattened; frontal vitta yellow, with the sides nearly parallel but perceptibly wider at the reclinate orbital than at either end, slightly more than twice width of parafrontal at lowest orbitals; five to six moderately strong bristles in frontal row; one reclinate and two proclinate orbital bristles; the orbitals, ocellars and inner verticals slightly larger than the frontal bristles; parafrontals silvery, bare or rarely with a few sparse hairs; facial ridges with one or two minute bristles just above vibrissae; face silvery; parafacials bare; in profile, buccal width one-fourth eye height; vibrissae slightly more than half length second antennal joint above front edge of oral margin; antennae extend four-fifths distance from their base to the vibrissae; second joint red; third joint black and three times as long as the second, straight along front edge with blunt point at outer apical angle; arista thickened on basal half; proboscis slightly less than head height; palpi yellow, distinctly clavate. Thorax gray pollinose over black, with bronze reflections on notum, and with three black vittae of which the median one is narrower than the other two; scutellum with three pairs of marginal bristles of which the extreme lateral pair is distinctly smaller than the apical, but both are much weaker than the intermediate pair. Abdomen shining black, excepting silvery pollinose bases of the last three segments, the pollinose bands less than one-third length of segments, terminating abruptly at the side and not continued ventrally; first segment without bristles, second with one lateral and one median marginal pair, third and fourth with marginal rows of about ten, the bristles of third segment as large or slightly larger than those of the fourth. Wings subhyaline, slightly smoky along the costal margin; last section of fourth vein slightly arcuate and not parallel to the hind cross vein which joins the fourth vein a little less than half the distance from its bend to the small cross vein; last section of fifth vein one-fourth the length of preceding section; two small costal spines; third vein with row of small bristles extending more than half way to small cross vein. Legs black; pulvilli less than half length of last tarsal joint; middle tibia with single bristle on outer front side near middle; hind tibia with row of two to four unequal bristles on outside extending to slightly below the middle.

Male.—Front at narrowest 0.39 of head width (measurements of three 0.36, 0.39, 0.41, respectively); frontal vitta diverging slightly towards vertex, more than three times width of parafrontal at lowest orbitals; third joint of antennae three and one-half times as long a second. A tuft of conspicuous hairs located on ventral side of

fourth abdominal segment. Genitalia in repose concealed within fourth abdominal segment so that apex is barely visible in lateral view; claws of inner forceps rounded and widely divergent from near base, in profile view, bent backward at middle and slightly forward at tip; outer forceps much stouter than inner pair, tapering gradually to spoonlike tips; penis with a black, heavily chitinized, S-shaped process on anterior part of hood. Pulvilli not more than half as long as last tarsal joint. Otherwise resembling the female.

Length, 4.5 mm.

Type.—In the University of Kansas Museum.

Range.—New York, New Jersey, Virginia, Ohio, Illinois, Mississippi, Florida, Kansas, New Mexico.

Host relationships.—Unknown.

Redescribed from the type, a female from southern Florida (Robertson); a male from the same locality (Robertson), and several other specimens in the University of Kansas Museum, the National Museum, the Museum of Comparative Zoology of Cambridge, Massachusetts, and the collections of Prof. J. S. Hine and the writer, from the following localities: one male, Baldwin, Kansas; one female, southern Illinois (Robertson); one female, Wild Horse Canyon, Animas Mountains, New Mexico, 5,000 feet; one female, Rosslyn, Virginia, May 1, 1913 (R. C. Shannon); one female, Woodbury, New Jersey; one female and two males from Falls Church, Virginia, the males from the honeydew of tulip-tree; one female, Ithica, New York, August 11, 1905 (H. E. Smith); one female, West Point, Mississippi, May 15, 1921 (H. W. Allen); one male, Agricultural and Mechanical College, Mississippi, April 2, 1921 (H. W. Allen); one male, Columbus, Ohio.

Townsend's type for *G. clarifrons* which is a male from southern Illinois, corresponds in all distinguishable characters with the type female of *polita* which is from southern Florida.

GYMNOPROSOPA ARGENTIFRONS Townsend

Gymnoprospa argentifrons Townsend, Trans. Amer. Ent. Soc., vol. 19, p. 109, 1892.—Coquillett, U. S. Bur. Ent., Tech. Ser., No. 7, p. 129, 1897, equals *Hilarella polita.*—Aldrich, Cat. N. A. Dipt., p. 447, 1905, equals *Hilarella polita.*

Male.—Front at narrowest 0.34 of head width (measurements of four 0.32, 0.33, 0.33, and 0.37, respectively); frontal vitta divergent from base of antennae, at most only sighsly wider at middle than at vertex, red, sometimes overlaid with silvery pollen, two to four times as wide as parafrontal at lowest orbitals; five to seven bristles in frontal row; one reclinate and two proclinate orbital bristles; no hairs on front outside of frontal rows; face silvery; antennae black, extending seven-eighths distance from base to vibrissae; third joint

with its front edge concave and its length five times that of second; arista thickened on basal three-fifths; facial ridges bare; parafacials bare or with almost imperceptible hairs; vibrissae inserted at less than half the length of second antennal joint above front edge of oral margin; in profile, head length at vibrissae distinctly less than at base of antennae, buccal width equaling one-fourth eye height; proboscis distinctly shorter than head height; palpi yellow and moderately calvate at tip. Thorax black, overlaid with gray pollen, tinged with bronze on notum; two widely separated broad black vittae, and occasionally a narrower indistinct median one; scutellum with three pairs of marginal bristles, the nearly equal apical and lateral pairs both smaller than the intermediate pair. Abdomen black, last three segments polished on their broad apices, white pollinose bands on anterior half of the segments which are not sharply defined from the black and are prologned laterally and ventrally to near median ventral line; abdomen clothed with usual black appressed hairs which extend well into the pollinose areas from behind; first segment without bristles, second with one lateral and one strong median marginal pair, third and fourth each with uninterrupted marginal rows of about eight, the bristles of the third scarcely equalling those of the fourth segment. Genitalia in repose, largely concealed within abdomen, normally extruding one-fourth length of fourth abdominal segment; claws of inner forceps flattened and united near the tip; outer forceps becoming slender near apex, then suddenly expanded into sharp-pointed, plow-shaped tips. Wings slightly infuscated; section of fourth vein beyond bend strongly arcuate; hind cross vein oblique to last section of fourth vein which it joins about two-fifths distance from the bend to the small cross vein; a small costal spine present; three to five small bristles on third vein extending about half way from its base to small cross vein. Legs black; pulvilli of fore feet varying from subequal to slightly longer than last tarsal joint; middle tibia with one bristle on outer front side near middle; hind tibia on outside with two or three unequal bristles not extending far beyond the middle.

Female.—Front at narrowest 0.385 of head width (in two specimens measuring 0.38 and 0.39 respectively); third antennal joint three and one-half to four times length of second. Genitalia of usual non-piercing type almost wholly concealed within the abdomen. Otherwise like the male.

Length, 4.0 to 6.0 mm.

Host relationships.—Unknown.

Redescribed from the type which is a male from southern Florida, loaned from the University of Kansas Museum and several other specimens as follows: In the collection of the National Museum, one female from southern Florida labeled "*Gymnoprosopa*"; one

male from Opelousas, Louisiana, May 1907; two females from Lafayette, Indiana, labeled July 12 and July 16, 1915 (J. M. Aldrich). In the collection of Nathan Banks, one female, July 4, two males and one female, July 12 from honeydew on tulip tree, one female on August 30 from honeydew on tulip tree, and another specimen on May 31, all from Falls Church, Virginia, collected by Nathan Banks. In my collection, one male from Starksville, Mississippi, May 10, 1923 (H. W. Chalkley).

GYMNOPROSOPA FILIPALPUS, new species

Male.—Front at narrowest 0.355 of head width (measurements of two 0.35 and 0.36 respectively); frontal vitta reddish-yellow, its sides parallel or sometimes widest at the middle where the width equals three to five times that of the parafrontal; six strong bristles in the frontal row; one reclinate and two proclinate orbital bristles; parafrontals silvery pollinose over yellow, all of face and bucca silvery; bristly black hairs extend from the orbitals down over parafacials to lower end of eyes; vibrissae not more than half length of second antennal joint above front edge of oral margin; facial ridges bare save for one or two hairs just above insertion of vibrissae; antennae extend almost to vibrissae; second joint dark brown to yellowish; third joint black, three and one-half to five times length of second; arista thickened on basal third; in profile, head length at vibrissae much less than at base of antennae, buccal width equals one-fourth eye height; proboscis two-thirds as long as head height; palpi pale-yellow, nearly filiform. Thorax gray pollinose over black with three shining black vittae of which the outer two are broad, the inner one much narrower; scutellum with three pairs of marginal bristles of which the lateral and apical pairs are equal, both much smaller than the intermediate pair. Abdomen shining black; segments two to four with gray pollen on their basal third; first segment without bristles, second with one lateral and one median marginal pair, the third and fourth each with a marginal row of six strong bristles. Genitalia in repose, almost completely concealed within abdomen; both genital segments black, sparsely covered with bristly hairs of the same size as those of the abdomen, first segment with a subapical row of about four distinct bristles; inner forceps black, sparsely covered with black bristly hairs, bulbous at base, tapering abruptly to slender tips which when viewed from behind are half as long as the basal part, claws moderately divergent at the tips; outer forceps yellow, as long as the inner pair, slender on apical half, slightly clavate at tip, curved gently towards tips of inner forceps. Wings infuscated towards costal margin, anal margin hyaline; section of fourth vein beyond the bend strongly arcuate; posterior cross vein perpendicular to fourth vein which it joins nearly halfway between

the bend and the small cross vein; one strong costal spine; third vein with three to four bristles which extend more than half way from its base to the small cross vein. Legs black; pulvilli of fore feet usually distinctly longer than last tarsal joint; middle tibia with a single bristle on outer front side near the middle; hind tibia on outside with two to four unequal bristles not extending far beyond the middle.

Female.—Front at narrowest 0.34 of head width (measurements of six 0.33, 0.33, 0.34, 0.35, 0.35, 0.35, respectively); pulvilli short, those of fore feet much shorter than last tarsal joint; genitalia of usual type and largely concealed within abdomen. Otherwise like the male.

Length, 3.5 to 5.5 mm.

Type and allotype.—Cat. No. 28163, U.S.N.M., type, male, McHenry, Mississippi. Allotype, female, Miami, Florida, September 8.

Host relationships.—Unknown.

Range.—Virginia, Georgia, Mississippi, Florida.

Described from the following material: In the National Museum, one male and three females from Georgia; one male from Enterprise, Florida; seventeen females from Miami, Florida, taken on several dates in September (C. H. T. Townsend); one male from McHenry, Mississippi, September 11, 1922 (H. W. A.). In the collection of Nathan Banks, three females from Falls Church, Virginia, June 2, July 4, and September 13, respectively, labeled "on chinquipin" (N. Banks). In the collection of J. R. Malloch, one male labeled June 24, and one female, June 17, Bancroft, Virginia, from flowers of *Ceanothus americanus* (W. L. McAtee).

GYMNOPROSOPA PALLIDA, new species

Male.—Front at narrowest measured in one specimen 0.36 of head width; inner orbits strongly narrowed at base of antennae; all of face and front including the vitta silvery pollinose, with dark reflections at the vertex; vitta pale yellow when viewed from above, moderately divergent from base of antennae to vertex, at level of lowest orbitals four to five times width of parafrontal; about nine bristles in frontal row; one reclinate and two proclinate orbital bristles; parafrontals beset with bristly hairs; vibrissae at level of oral margin; antennae black, extending five-sixths distance to vibrissae, third joint four times length of second; arista thickened on basal three-fifths; facial ridges divergent, with only one or two microscopic hairs just above the vibrissae; in profile, bucca narrower than parafacials and equal to one-eighth eye height, front projects over one-third eye diameter, head length at vibrissae much less than at base of antennae; palpi yellow with blackish tips, strongly clavate. Thorax thinly gray pollinose over black, with five obscure black vittae of which the outer two are broader than the three narrow median ones; scutellum with three pairs of marginal bristles, the lateral pair distinctly larger than

the apicals and both smaller than the strong intermediate pair; preapicals present. Abdomen black, sides of first and second segment dull-reddish; last three segments with a pollinose band on the basal half, which is invaded from behind by many bristly hairs; first two segments each with a median marginal pair of bristles, the third with a median marginal pair and two or three laterals, the fourth with a marginal row of about ten bristles; macrochaetae of middle segments of the same size as those of fourth segment. Genitalia black, in repose largely concealed within tip of abdomen and not visible from the side. Wings hyaline; hind cross vein nearly parallel to section of fourth vein beyond the bend; costal spine lacking; one bristly hair at base of third vein. Legs black; pulvilli of fore feet less than one-fourth length of last tarsal joint; middle tibia with a single bristle on outer front side near the middle; hind tibia with four to five unequal bristles on outside extending to slightly beyond the middle.

Length, 4.0 mm.

Type.—Male, Cat. No. 28164, U.S.N.M.

Host relationships.—Unknown.

Described from a single male from Horseshoe Bend, Idaho, collected by Dr. J. M. Aldrich in 1900.

GYMNOPROSOPA INFLATICORNIS, new species

Female.—Front at narrowest 0.4 of the head width from measurements of two which were 0.40 and 0.40 respectively; frontal vitta yellow, sides parallel or slightly expanded at the middle where width of vitta is three times that of parafrontal; parafrontals gray pollinose, merging into silvery pollinose on face and bucca; about ten bristles in the frontal row, those at the back scarcely larger than the parafrontal hairs which are most densely grouped just anterior to the lowest ocellus, where a few hairs occur on the frontal vitta between the frontal rows; one reclinate and three or four proclinate orbital bristles; vibrissae level with front edge of oral margin; facial ridges with a small cluster of bristly hairs on the lowest fifth; antennae extend five-sixths distance from their base to the vibrissae; second joint brown; third joint black, inflated saclike, conspicuously pitted, not pointed at the outer apical angle, from three and one-half to four times length of second joint; arista thickened on basal half; parafacials sparsely beset with black bristly hairs, continuous from parafrontals; in profile, bucca equals one-third eye height; proboscis distinctly shorter than head height; palpi clavate, yellow with blackish tips. Thorax gray pollinose over black, with three obscure vittae; scutellum with three pairs of marginal bristles of about equal size and a somewhat smaller preapical pair. Abdomen shining black, last three segments with white pollinose bands sharply defined from the black and confined to basal half of the segment but

prolonged laterally and ventrally to near the median ventral line; second segment with a lateral and one median marginal pair of bristles, third and fourth each with a marginal row of about eight; all abdominal macrochaetae weak, being comewhat shorter than the segment upon which they occur. Wings hyaline; fourth vein beyond bend but slightly arcuate, parallel to hind cross vein; last section of fifth vein equals one-third preceding section; one very small costal spine; three or four small bristles on third vein extending scarcely halfway to small cross vein. Legs black; pulvilli distinctly shorter than the last tarsal joint; middle tibia with one bristle on outer front side near middle; hind tibia on outside with row of six to nine unequal bristles, extending considerably below the middle.

Male.—Not known.

Length, 4.0 to 5.0 mm.

Type.—Female. Cat. No. 28165, U.S.N.M. Pecos, New Mexico.

Host relationships.—Unknown.

Described from two females in the National Museum from the following localities: Pecos, New Mexico, September. 5 (Cockerell); Las Vegas, New Mexico, 1918, labeled "T. D. 4430" (H. S. Barber).

EXPLANATION OF PLATES

PLATE 1

a c=anterior claspers; *i f*=inner forceps; *o f*=outer forceps; *p*=penis; *p c*=posterior claspers.

FIG. 1. Male genitalia of *Metopia leucocephala* Rossi.
2. Male genitalia of *Metopia campestris* Fallén.
3. Male genitalia of *Hilarella hilarella* Zetterstedt.
4. Male genitalia of *Sphenometopa tergata* Coquillett.
5. Male genitalia of *Opsidia gonioides* Coquillett.
6. Male genitalia of *Phrosinella fulvicornis* Coquillett.

PLATE 2

For explanation of letter see Plate 1.

FIG. 7. Male genitalia of *Senotainia trilineata* Van der Wulp.
8. Male genitalia of *Senotainia rubriventris* Macquart.
9. Male genitalia of *Senotainia flavicornis* Townsend.
10. Male genitalia of *Senotainia litoralis* Allen.
11. Male genitalia of *Senotainia vigilans* Allen.
12. Male genitalia of *Pachyophthalmus floridensis* Townsend.

PLATE 3

For explanation of letters see Plate 1.

FIG. 13. Male genitalia of *Pachyophthalmus signatus* Meigen
14. Male genitalia of *Pachyophthalmus distortus*, new species.
15. Fore tarsus of male, *Phrosinella pilosifrons*, new species, viewed from the side.

FIG. 16. Fore tarsus of male, *Phrosinella aldrichi*, new species, viewed from the inside.
17. Fore tarsus of female, *Phrosinella fulvicornis* Coquillett, viewed from above.
18. Fore tarsus of male, *Sphenometopa nebulosa* Coquillett, viewed from the side
19. Fore tarsus of male, *Metopia campestris* Fallén, viewed from above.

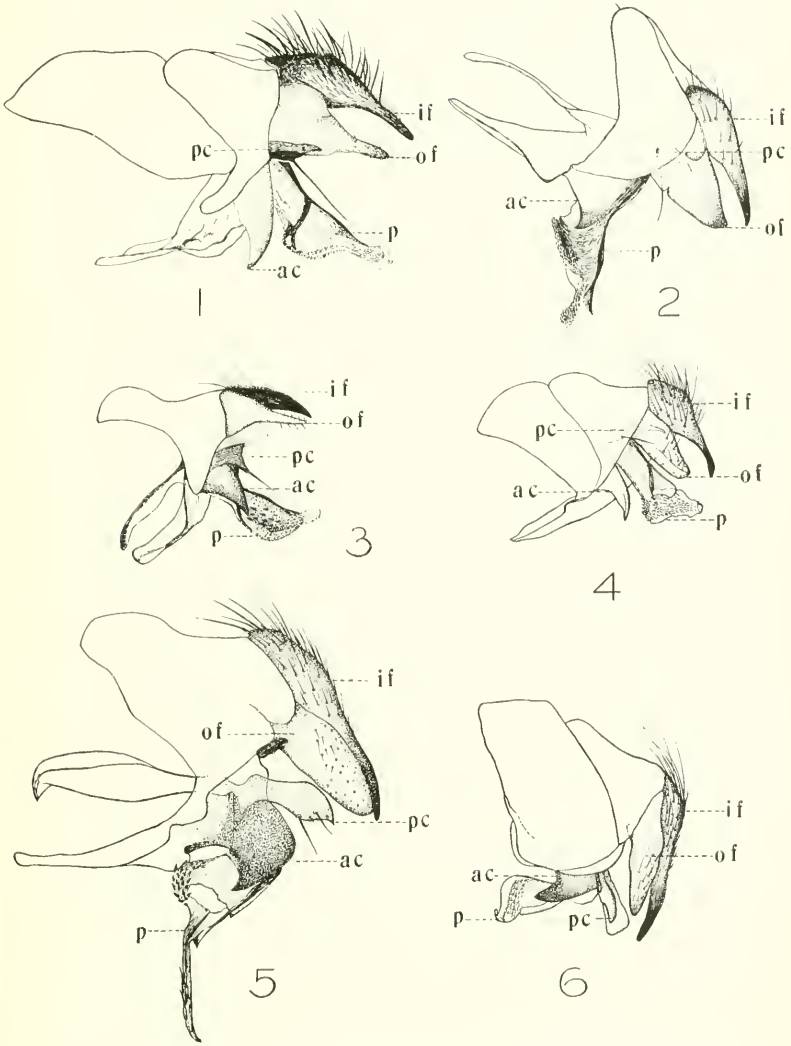
PLATE 4

a g=accessory gland; *a p*=accessory pouch of uterus; *o*=ovary; *o d*=oviduct; *s*=spermatheca; *u*=uterus

FIG. 20. Reproductive organs of female, *Senotainia trilineata* Van der Wulp.
21. Puparium of *Senotainia vigilans* Allen, Dorsal aspect.
22. Reproductive organs of female, *Senotainia vigilans*.
23. Head of *Senotainia vigilans*.
24. Wing of *Senotainia vigilans*.
25. Reproductive organs of female, *Senotainia litoralis* Allen.
26. Egg (from uterus) of *Opsidia gonioides* Coquillett.

PLATE 5

FIG. 27. Posterior end of puparium of *Senotainia vigilans* Allen. *d*=spiracular depression; *s l*=slits in posterior spiracle; *st*=posterior spiracle or stigma
28. Second instar larva of *Senotainia trilineata* Van der Wulp. Lateral aspect of anterior end. I, II, and III=thoracic segments; *a s*=anterior spiracle.
29. Buccopharyngeal armature of the first instar (uterine) larva of *Phrosinella fulvicornis* Coquillett. *b p*=basal piece; *l h*=lateral hooks; *m h*=median hook; *p-II*=H-piece.
30. Buccopharyngeal armature of the first instar (uterine) larva of *Senotainia rubriventris* Macquart. For explanation of letters see fig. 29.
31. Buccopharyngeal armature of the first instar (uterine) larva of *Senotainia trilineata* Van der Wulp. For explanation of letters see fig. 29.
32. Buccopharyngeal armature of the first instar (uterine) larva of *Senotainia litoralis* Allen. For explanation of letters see fig. 29.
33. Buccopharyngeal apparatus of the first instar (uterine) larva of *Senotainia vigilans*. For explanation of letters see fig. 29.
34. Buccopharyngeal armature of the second instar larva of *Senotainia trilineata* showing the lateral hooks of the succeeding instar in process of formation. *a p*=accessory process of the basal piece; *b p*=basal piece; *i p*=intermediate or H-piece; *l h*=lateral hooks; *l h III*=lateral hooks of the third instar partly formed.
35. Diagramatic outline of spiracular depression at posterior end of puparium of *Phrosinella fulvicornis*. For explanation of letters see fig. 27.



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FOR EXPLANATION OF PLATE SEE PAGE 103

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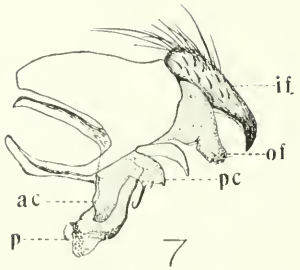

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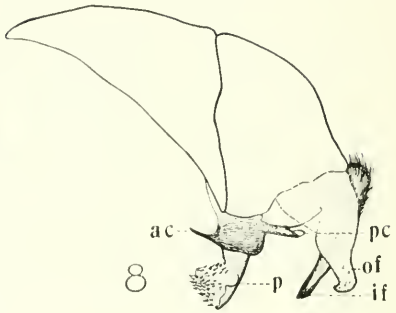

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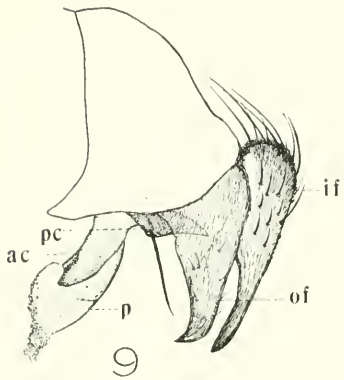

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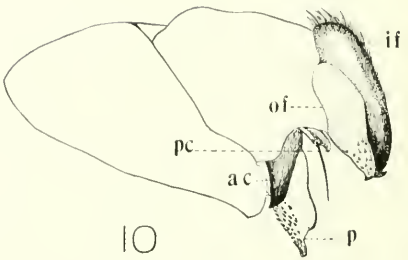

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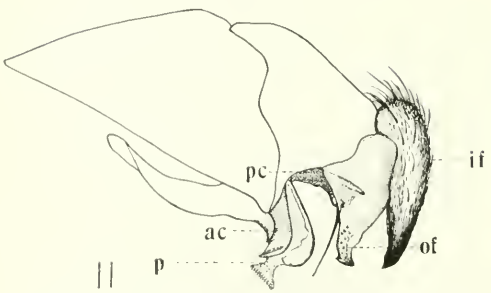

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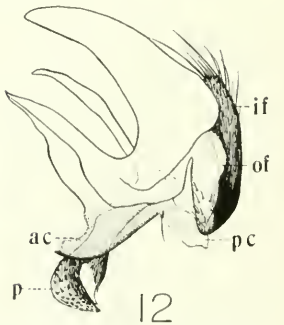

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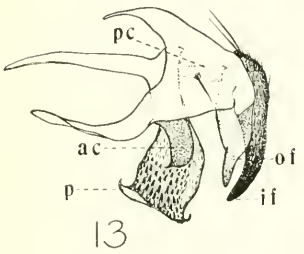

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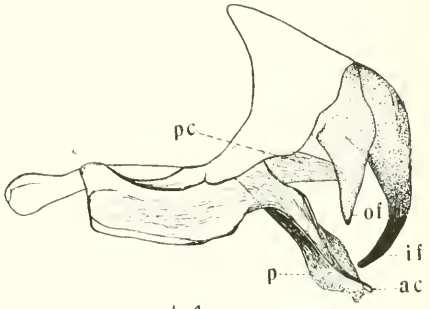

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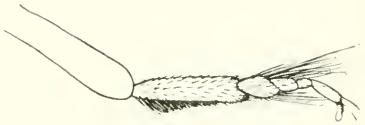

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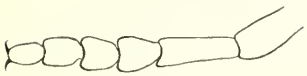

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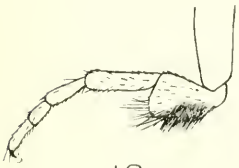

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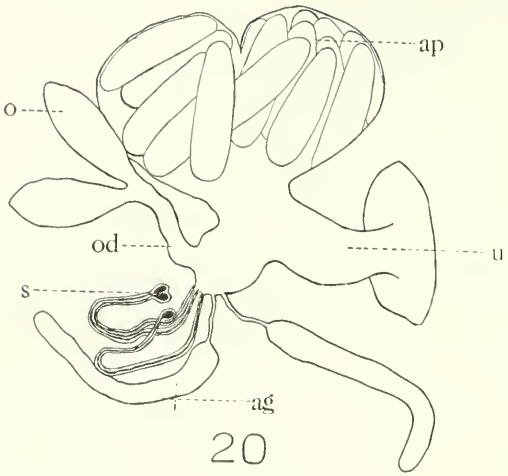

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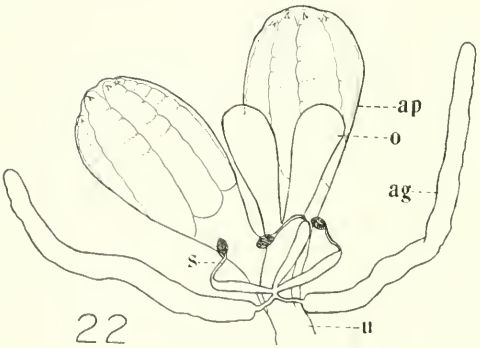

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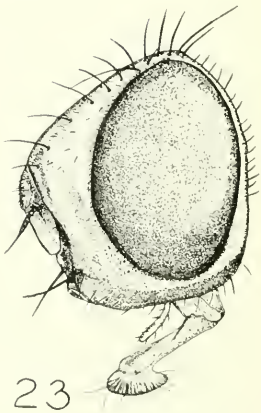

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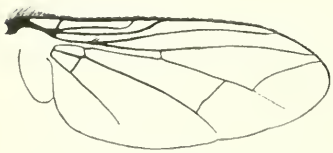

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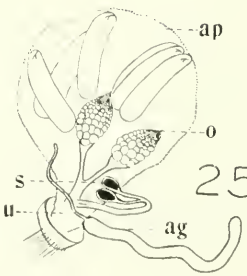

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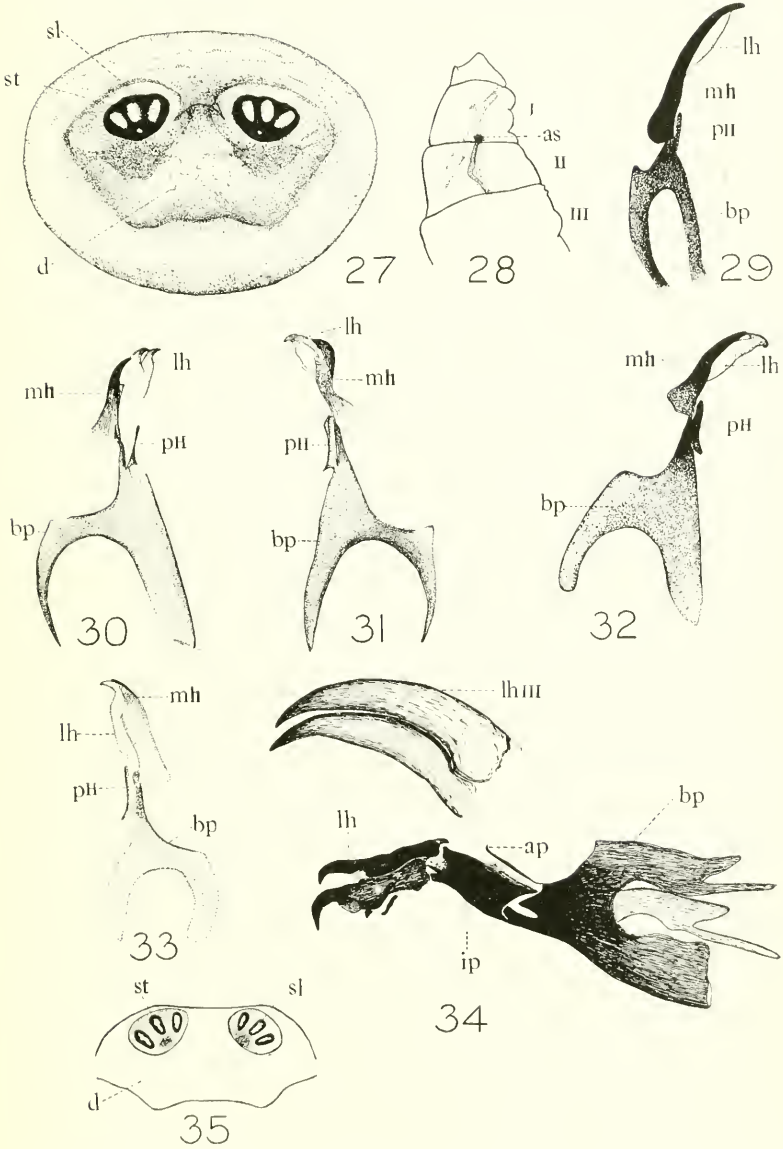

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FOR EXPLANATION OF PLATE SEE PAGE 104

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This index includes all of the generic and specific names of flies treated in this paper. The valid generic names are in **bold-faced** type; the valid specific names in Roman; synonymy in *italics*. Where more than one page reference occurs, the most important one is given last.

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FIELD NOTES ON GALL-INHABITING CYNIPID WASPS WITH DESCRIPTIONS OF NEW SPECIES

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The present paper, dealing with the true gallflies (Cynipidae) of the order Hymenoptera, contains descriptions of 53 new species (of which all but two guest flies from the Philippines are from the United States), descriptions of the associated sex of 5 old species described from one sex only, and biological notes on about 180 other described species. It was prepared under the general direction of S. A. Rohwer, custodian of Hymenoptera in the United States National Museum, where types of the new species are deposited.

The beginner in the study of the gall-making Cynipidae is handicapped and often discouraged by the lack of published information as to the date of emergence of the maker of the gall. Not knowing what time of year to collect the galls to get the maker, he rears nothing or gets only guests or parasites. Some general suggestions on this point, applying only to Cynipid galls, however, may be of value. Galls on herbaceous plants like *Fragaria*, *Potentilla*, *Nepeta*, *Silphium*, *Ambrosia*, *Microseris*, *Hypochoeris*, *Lactuca*, *Lygodesmia*, and *Prenanthes* may be collected in the fall if they can be put where they will not dry out too much but are better left in the open all winter and brought into the laboratory in the spring. A pasteboard box with a vial or test tube in one side makes a convenient breeding cage. Many galls on shrubby plants like *Rosa*, *Rubus*, and *Chrysothamnus* may be treated in the same way. The succulent vernal galls on the leaves, buds, and flowers of oak must, however, usually be left on the tree until the larvae within use up all the nutritive layer of plant tissue and transform into pupae but such species develop rapidly and it is a matter of leaving them some days or at most but a few weeks longer. When the larvae are about mature or the pupa stage is reached twigs bearing such galls can be put in a bottle of water with cotton plugged tightly around the stems at the mouth of the bottle so that the emerging flies can

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not crawl into the water and become drowned. This bottle should then be set in a battery jar with muslin tied over the top—if set under a bell jar the condensation water on the glass will wet the wings of the flies. From galls of this type come active, fully-winged adults of both sexes whose adult life is short.

The more solid autumnal galls on oak, maturing and dropping just before or with the leaves, contain at that time when they are usually gathered a scarcely visible larval cavity in a thick translucent nutritive layer which is used up slowly during the winter. Such galls should be kept under more or less natural conditions out of doors on the ground in some sort of wire cage. Select a shady spot in the woods if possible where there is a deep layer of leaf mold, safe from molestation and from fire in summer and well buried under snowdrifts in winter. Mice and squirrels are liable to destroy collections unless wire cages are used. Labels inside should give locality, date and host and may be written with waterproof ink on paper and then dipped in melted paraffin or better inclosed in a well-corked 7 by 25 mm. vial. The year of collection should not be omitted in the date. Two winters often pass before any flies appear and then some may emerge each spring for several years. The larvae transform in the fall before they emerge and remain as adults in the galls during the winter to come out when conditions are suitable in the spring. Adults may often be secured by cutting open galls in the late fall or winter but in this case it is better to let them crawl about in a vial until the chitin hardens and takes on its normal color rather than to kill them at once in a cyanide bottle. Adults from galls of this type are all agamic females and are comparatively long-lived, often surviving for a month or more in captivity. Many species normally emerge in the late fall, for example, all those of the genus *Disholcaspis* (whose galls on twigs are in general bullet-shaped, detachable but not deciduous) and many wingless agamic forms such as species of *Acraspis*, *Xanthoteras*, *Zopheroteras*, etc. Some woody stem swellings on oak become so hard after being gathered that the insects even if they have already transformed can not chew their way out and it is better to cut them out. These are but general suggestions for the beginner and their value is indicated by the fact that the writer knows many kinds of galls which he has never yet been able to rear. A single gall casually collected is seldom worth the trouble of rearing. It may be the normal reaction of the plant to the Cynipid maker and it may be quite abnormal if that structure is modified by guests or parasites and some field observation may be necessary to determine whether this is the case. Collecting of value usually requires definite search for quantities of material with the object of rearing in view. When gathering galls from

the ground in the fall especial care must be taken that no galls of other kinds are included in the cages.

For a number of years the writer lived at Evanston, Ill., and collected galls either within the city limits or along the north branch of the Chicago River 4 miles west and along the "north shore" as far north as Waukegan with occasional trips to the sand dune area at the southern end of the lake in Indiana and less frequent ones to the general region of the "sag" southwest of Chicago. In this "Chicago area" the writer found a total of 124 species of gall-making Cynipidæ of which 10 are here described as new. In addition he has field notes on some 30 other galls from this area either not determined or not reared and hence not otherwise here mentioned. Further collecting will no doubt yield still other species, for during the last year or two of residence there it was no unusual experience to find galls that years of previous collecting had never discovered. Moreover, collecting on three of the nine oaks in the region was very fragmentary, these being seen hardly more than once or twice a year. Strangely enough, *Diastrophus smilacis* Ashmead, described from the Chicago area as producing a gall on *Smilax*, the writer has never been able to find although he has looked for it for years. The oak openings at the edge of the prairie now transformed into the suburbs of a densely populated metropolitan district would not be suggested as an ideal region for Cynipid collecting and yet it will be interesting to compare its 125 species with the few published local lists available. In 1904 Beutenmueller listed 46 of the more conspicuous Cynipid galls in the vicinity of New York City. Stebbins in 1910 listed 66 from Springfield, Mass. Sixty-four are known for the Toronto area.

To make available to students the writer's experience with those species of the Chicago area which have either been reared or are felt to be determined with some certainty these field notes are prepared. Some species of the Chicago area producing galls on roots or in acorns were discussed in previous papers and are not included in the present one. To these are added selected species from other localities in cases where sufficient material was at hand for description or the writer felt he was able to make some contribution to the knowledge of the species by indicating date of emergence, supplying a host record, or adding additional hosts, or supplementing the published data of geographical distribution.

Many years ago Dr. William Brodie gave his large collection of insects reared from galls to the United States National Museum. It occupies 22 museum drawers. Each specimen bears a field note number but the notebook which would have interpreted these numbers was long supposed to have been lost. However, in the

summer of 1922 A. Cosens, of Toronto, learned of its existence and with the consent of Doctor Brodie's daughter, Miss Jessie Brodie, was able to borrow the book and send it to the museum to be copied so that the locality and emergence data for this mass of material is now available. Whenever these notes supplied additional data for the species under discussion in this paper such information has been added. Some records have also been taken from the files of the Eastern Field Station of the Bureau of Entomology for the study of forest insects.

Except for figure 18 which is from a negative in the eastern field station the photographs and drawings are by the author. The natural size of the galls is represented in the photographs except when otherwise indicated.

The generic names used are mainly those of the last monograph on the Cynipidae—that of Dalla Torre and Kieffer in Das Tierreich, Lieferung 24, 1910. The names of the oaks are those used in the monograph "The American Oaks," by William Trelease, published as a memoir of the National Academy of Science (vol. 20, 1924). This monograph did not appear until months after the manuscript was prepared and long after labels had been attached to the specimens, but the necessary changes in the names of the oaks were made after the paper went to press. Consequently the host oak label on the specimen will not always correspond with the name of the oak as published. For example a *Q. rubra* label will be found on the pin to indicate the northern red oak now known as *Q. maxima;* a *Q. prinus* label for the rock chestnut oak, *Q. montana; Q. michauxii* for the basket oak, *Q. prinus; Q. pungens* for *Q. undulata*, etc. A photographic name label on each type specimen together with the red type label should obviate any confusion as to identity of type material, despite the discrepancy in the name of the host oak.

NEUROTERUS BATATUS (Fitch)

The woody winter form of the "oak potato gall" on the stems of *Quercus alba* has been noted at Evanston, Glencoe, Ravinia, and Fort Sheridan, Ill.; Miller, Ind.; Marianna, Fla.; Washington, D. C., and Blue Hills, Mass. In the Chicago area the agamic females issued April 15–24, 1910, and were observed to oviposit in buds at end of the same twig in breeding jar. In 1913 they emerged April 20–26. At Washington they were emerging March 14, 1921. Brodie found the galls not quite full grown by the 1st of August, adults emerging in various years April 21, 1886, May 6, 1888, May 11–22, 1889, May 7–9, 1890. He "bred over 1,000 of the producers without finding one male. Some appear to come out late in the fall but the greater number early in the summer—May."

The succulent stem galls of the sexual generation on the new growth were seen at Evanston and Fort Sheridan, Ill., and Michigan City, Ind., the adults emerging at Evanston June 16–25, 1913; at Michigan City June 26, 1906. At Apple Orchard Camp in Bedford County, Va., adults of both sexes were emerging on July 1. Brodie found the new galls nearly full grown on June 9 about a month after the agamic flies had issued. On May 5, 1892, he collected galls on what seems from both notes and specimens to be the new growth and from May 24 to June 1 reared 1,431 males and 341 females.

NEUROTERUS DISTORTUS Bassett

The writer has collected galls of this species on *Quercus bicolor* at Evanston, Wilmette, Glencoe, and New Lenox, Ill. The flies issue during the first two weeks of May. A similar gall perhaps of this species was observed on the rock chestnut oak, *Q. montana*, near Alexandria, Va.

NEUROTERUS ESCHARENSIS, new species

Agamic female.—Piceous. Head coriaceous but shining, a few short white hairs on face; from above transverse, length to width as 12:28, occiput not concave, cheeks broadened behind the eyes which are not protuberant; from in front broader than high, facial area square, malar space one-fourth eye with groove, antenna 12-segmented, lengths as (scape) 23 (width 12) : 20(13) : 28(7) : 22 : 20 : 20 : 18 : 18 : 16 : 16 : 16 : 26(10), last without trace of subdivision. Pronotum microscopically coriaceous on sides. Mesonotum with a few short scattered hairs more noticeable on disk, no trace of parapsidal grooves. Wings hyaline, pubescent, and ciliate, first abscissa of radius angled and at right angle to second which is nearly straight and nearly parallel with free part of subcosta making the open radial cell about seven times as long as broad at base. Areolet reaching one-fifth way to basal, cubitus fainter but reaching basal on its lower third, second intercubitus at right angles to fore wing margin; a faint cloud about break of anal. Hind tibia and tarsus equal, claws simple. Abdomen slightly longer than thorax, higher than long, compressed, lengths of tergites about as 19 : 9 : 7 : 5 : 5, ventral valves not evident, ventral spine short, ovipositor protruding. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 1.9, ovipositor 3.9, wing 4.5. Length, 1.0–1.6 mm. Average of 18 specimens, 1.25 mm.

Type.—Cat. No. 27180, U.S.N.M. Type and 7 paratypes. Paratypes in Field and American Museums.

Host.—*Quercus bicolor.*

Gall (fig. 1).—A minute cell hidden in the tissue of the twig under a leaf scar, the tip protruding so slightly as to be scarcely noticed until the adult within begins to cut out a hole by which to emerge. Sometimes two cells occur side by side under the same leaf scar and more rarely the exit hole is just above the boundary of the scar. They may be found in winter or spring in previous seasons' growth usually underneath the scars just below the terminal bud cluster.

Biology.—On April 24, 1909, flies were found at Evanston, Ill., ovipositing on the buds of *bicolor*, perched on the side of the bud with the ovipositor thrust perpendicularly through the bud scales. Investigation revealed the galls described above in the leaf scars under these buds with adults just emerging. In 1913 similar galls were collected in Wilmette and insects reared. In 1915 they were found again on April 17 when some adults had already gone and one was seen ovipositing in a bud. On April 10, 1916, twigs containing cells were collected and brought into laboratory and put in water and by April 15 several flies had issued and three were seen ovipositing in the side of buds in this indoor cage. By May 8 when the young leaves were over one-half inch long three small galls were found from which the insects had already emerged and one was found ovipositing in the axil of one of the young leaves. From such scanty evidence and material no attempt is here made to describe either the adult or the gall of an alternating generation but this may be suggestive to students who live where they can work further on this life history. A precisely similar gall was found at Ravinia on *Q. alba* after the adults had emerged.

Habitat.—The type has been selected from the flies reared in 1913 at Wilmette, Ill., where conditions are such that native trees of the host oak will long persist. Paratypes are from Evanston and include those taken ovipositing as well as those reared.

NEUROTERUS EVOLUTUS, new species

Female.—Black with knees, front tibiae, and all tarsi brownish. Head and thorax micro-coriaceous; head from above transverse, cheeks broadened behind the eyes, occiput not concave; from in front facial area broader than high, malar space one-third eye with groove, antenna 13-segmented, lengths as (scape) 7:6:10:8:7:7:6:6:6:5.5:5:5:7. Mesonotum shining, without trace of grooves. Claws simple. Wing hyaline, pubescent, ciliate, veins distinct and brownish, first abscissa of radius angled, intercubitus at angle of 52° with basal, areolet reaching one-fourth way to basal, somewhat symmetrically placed below apex, cubitus reaching basal on its lower third, a faint cloud about break in anal and in first cubital cell.

Abdomen in living specimens longer than head and thorax, collapsing in drying, tip of ventral valves and ovipositor protruding, ventral spine in side view scarcely as long as broad. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.4, wing 5.0, ovipositor 5.4.

Length 1.4–2.2 mm. Average of 40 specimens 1.87 mm.

Type.—Cat. No. 28057, U.S.N.M. Type and 9 paratypes. Paratypes in American Museum, Field, Harvard, Stanford, California Academy, and Philadelphia Academy.

Host.—Quercus lobata.

Gall.—A cell about 1.8 mm. long lying in the wood under a leaf or flower scar, the upper end nearly reaching but not showing at the surface until the adult begins to make the exit hole. But one or rarely two under a scar. Exit hole in the scar or near it. Found about the terminal cluster of buds or sometimes at the internodes forming the annual ring. Similar to the gall of the eastern species described above but the adult is different.

Habitat.—Cottonwood, Shasta County, Calif. Twigs collected by A. W. Gambs on December 7 gave adults indoors January 6 and from others collected late in January adults emerged February 9 and 11. The normal emergence is probably before the buds start in the spring.

NEUROTERUS EXIGUUS Bassett

Spindle-shaped fleshy enlargements of the staminate flower axis of *Quercus stellata* at Alexandria, Va., gave adults of this *Neuroterus* on May 12, 1920. The galls were also seen at Rosslyn. Along with these swellings and sometimes on them were tan-colored, thin-walled, somewhat hairy, oval galls evidently representing enlarged filaments which also seem to contain this *Neuroterus.*

NEUROTERUS FLOCCOSUS (Bassett)

Galls of this species on *Quercus bicolor* were common in fall at Evanston, Ill., often deforming all the leaves near the tip of thrifty sprouts. Adults issued April 15. Have had specimens of gall from Becker, Minn., (L. Haney) and the Pergande collection contained galls from St. Louis, Mo.

NEUROTERUS IRREGULARIS (Osten Sacken)

Galls collected at Clarendon, Va., but a few miles from the type locality of this species, on an isolated tree of *Quercus stellata* on which fully half of the leaves bore galls, gave adults May 14–20, 1923. At this time the recently emerged flies were seen resting on the leaves by hundreds, the females ovipositing on the under surface. In early September this tree bore thousands of small, nearly spheri-

cal, short-pubescent galls recently described as those which yield in March the agamic fly *Neuroterus saltatorius australis* Kinsey. No other kind of gall was noticed on the tree. In the spring of 1924 the nearly full-grown galls on the leaves were observed again and globular galls collected from the ground beneath still contained larvae indicating that some at least hold over in the galls for two winters before emerging. Adults of *irregularis* emerged May 24–6, 1924. Another tree some miles away at Takoma Park, Md., bore countless number of these spherical galls which were dropping to the ground in the latter part of September 1923, and this tree was one on which *irregularis* had been very abundant in the spring. These galls were not observed to jump. In Arlington Cemetery, Va., a tree was seen so heavily infested with *irregularis* galls in the spring of 1920 that on July 4 the tree was observed to have put forth a new crop of leaves as a result. A sending of fresh galls from Middleburg, Va., yielded 487 adults of which 136 were females and 351 or 72 per cent males.

NEUROTERUS MAJALIS (Bassett)

The writer has collected galls on *Quercus alba* at Willow Springs, Evanston (adults emerged June 11–13, 1909), Ravinia, and Fort Sheridan (adults emerging May 30, 1911), Ill.; at Miller, Ind.; at Fairfax, S. C.; at Poplar Bluff, Mo.; at Plummer Island, Md.; and Washington, D. C. The galls are much more common about Washington than in the Chicago area and are full grown early in May when the young leaves are but 5–6 cm. long. Similar galls were noted on the rock chestnut oak, *Q. montana*, at Washington and at Falls Church and Alexandria, Va., where adults emerged May 6–11, 1920 and some seemed to be ovipositing on the leaves.

NEUROTERUS MINUTISSIMUS (Ashmead)

The writer has collected galls in Florida at Jacksonville, Daytona, St. Petersburg, Clearwater, and Ocala, but has never reared adults which are said to emerge in spring. The Pergande collection had galls from St. George also.

NEUROTERUS MINUTUS (Bassett)

The galls of this species have been taken at Winnetka, Ravinia, and Moline, Ill.; at Plummer Island and Takoma Park, Md.; at Washington, D. C.; at Falls Church and Alexandria, Va.; and at Fairfax, S. C. In the Chicago area the galls are rare and contained pupae one year on May 30 and the next year on June 9. Adults were all out at Moline by June 19. About Washington the galls are very abundant especially in 1924 when two large white

oaks had almost every twig end affected. The galls contained pupae on May 4 and adults emerged May 6–12, males appearing first. Galls collected at Falls Church May 2, 1920, gave adults May 7. Brodie found galls at Toronto.

NEUROTERUS NOXIOSUS (Bassett)

The woody stem galls of the agamic generation are very conspicuous in winter on certain trees of *Quercus bicolor* at Evanston, Ill., the adults emerging April 10–14, 1909, April 1, 1910, and May 10, 1913. They were seen to oviposit in buds, thrusting the ovipositor perpendicularly through the bud scales just as the buds were beginning to swell. By May 30 a slight bulging of the midrib of the young leaves then an inch and a half long has been noted and the galls of the alternating generation are full grown by June 30, greatly deforming the leaves. The adults emerged June 12–July 3, 1906. On July 22, 1912, the young stem galls of the winter form were half grown but still green and succulent with no larvae visible. What seemed to be the galls of the sexual generation of this species were collected at Greenport, Long Island, by R. Latham.

NEUROTERUS PAPILLOSUS Beutenmueller

Parenchyma galls in the leaves of *Quercus bicolor*, agreeing with the type galls of this species, were collected at Chesterton, Ind., June 25, the adults emerging June 27–29, 1912. They occurred on the leaves of thrifty sprouts and on lower branches of a small tree near by. Exit holes on lower side. Galls were also taken at Wilmette, Ill., June 9, 1913.

NEUROTERUS PERMINIMUS Bassett

The species was described from the sexual generation emerging in late June or early July from oval parenchyma galls in the current season's leaves of *Quercus alba*. The galls the writer refers to this species differ only in being found in October and yielding adults, all agamic females, in the early spring. Galls collected at Evanston, Ill., gave flies April 1–23, 1909, and in 1910 from April 4–20. Brodie collected galls in October and reared adults May 9, 1888.

NEUROTERUS RILEYI (Bassett)

Galls determined by writer as this species were sent to the National Museum December 12, 1920, from Sulphur, Okla., host oak not given.

NEUROTERUS SADLERENSIS, new species

Female.—Head (except about mouth) and abdomen black; thorax brownish, legs yellowish with hind femur and coxa more or less in-

fuscated, antennae light yellow. Head coriaceous under lens, as broad as thorax, scarcely enlarged behind eyes, eyes not protuberant, face slightly pubescent, malar space one-fourth eye with a groove, antenna 13-segmented, lengths as (scape) 40:26:50:37:32:32:31:30:28:27:25:24:34. Mesonotum length to width as 40:28, mesoscutum about as broad as long, shining, microscopically coriaceous, without parapsidal grooves, collapsible, with a few scattered short white hairs. Disk of scutellum smooth, polished, with scattered hairs. No carinae on propodeum. Tarsal claws weak, simple. Wing subhyaline, short-pubescent, ciliate, veins brown, first abscissa of radius angulate, second nearly straight, areolet reaching one-fifth way to basal, would be bisected by a perpendicular drawn through its anterior angle, cubitus reaching basal near its lower end. Abdomen higher than long, truncate behind, much compressed and distorted, ovipositor far exserted. Ventral spine not as long as lobes of hypopygium. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 2.5, ovipositor 4.1, wing 3.9. Length, 1.45–2.05 mm. Average of 32 specimens, 1.72 mm.

Male.—Thorax, legs and antennae light yellow, vertex and cheeks infuscated, eyes black, abdomen back of petiole nearly black. Cheeks not broadened behind the eyes, eyes slightly protuberant, antenna 14-segmented, lengths as (scape) 43:28:75:50:42:44:42:42:40:39:37:35:33:37, second only slightly curved. Mesonotum length to width as 54:34. Abdomen about as long as thorax, compressed to a knife-edge above, lengths of tergites along dorsal margin as (petiole) 7:21:12:10:9:9:10. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 3.2, wing 4.7. Length, 1.65–2.15 mm. Average of 24 specimens 1.91 mm.

This is the first cynipid to be reported from Sadler's oak. The species would go in the subgenus *Dolichostrophus* and is related to *Neuroterus washingtonensis* Beutenmueller.

Type.—Cat. No. 27181, U.S.N.M. Type female, allotype, 7 male and 11 female paratypes. Paratypes at American Museum, Field, Stanford, Harvard, Philadelphia Academy, and California Academy.

Host.—Quercus sadleriana.

Gall (fig. 28).—Greenish-yellow succulent enlargement of the midrib and adjacent parenchyma of the basal portions of the outermost leaves in a terminal cluster and causing a more or less complete reduction of the blade of the inner leaves in the cluster producing a conspicuous rosette at the end of the twig. In July.

Habitat.—The type material was collected July 20, 1922, on the ridge above the Oregon Caves National Monument in the Siskiyou mountains near Holland, Oreg., at an elevation of 6,000 feet. Adults of both sexes emerged by July 28.

NEUROTERUS SALTARIUS, new species

Agamic female.—Black, flagellum infuscated, lighter at base, tarsi pale, tibiae infuscated, knees pale. Head coriaceous, cheeks not enlarged behind eyes, eyes scarcely protuberant, malar space one-fourth eye, with groove, antenna 13-segmented, lengths as (scape) 23 (width 12) : 20(11) : 28(7) : 14 : 13 : 14 : 14 : 15 : 15 : 16 : 15 : 14 : 21. Mesonotum smooth, naked, polished, length to width as 31 : 21, no trace of grooves. Mesopleura polished. Claws simple. Wing hyaline, pubescent, ciliate, veins brown, first abscissa of radius angulate, second at right angles, straight, radial cell five times as long as broad, areolet indistinct, second intercubitus set at an angle of 55° with basal, cubitus faint, reaching basal half-way below middle. Abdomen as long as head and thorax, more or less collapsed, ventral spine twice as long as broad. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 1.9, ovipositor 2.8, wing 4.1. Length .8–1.2 mm. Average of 42 specimens 1.0 mm.

Type.—Cat. No. 27182, U. S. N. M. Type and 13 paratypes. Paratypes in Field Museum, American Museum, and Stanford.

Host.—Quercus macrocarpa.

Gall (fig. 2).—Small, seed-like bodies, inserted in cup-like depressions on the under surface of leaf and causing a prominent light-colored bulging on the upper side of the leaf opposite, often two or three hundred on a leaf, less numerous on the basal part of leaf blade. When growing the galls are greenish-white, somewhat globular, flattened above with a papilla in center and a raised rim, not pubescent. They start to develop in June and in July or August drop to the ground where they exhibit the phenomenon of bouncing about until they lodge in some crevice in the soil where they pass the winter. When detached a large scar is left on base of gall. During the winter the galls become tan-colored and somewhat compressed laterally, one measured 1.2 mm. long by .9 mm. thick and 1.1 mm. high.

This gall seems to have been first described in 1876 by Riley who unfortunately applied to it the name of a California species with similar jumping habits. Under this name the eastern gall has been mentioned many times in literature and good figures have been published of it but up to the present no one seems to have reared the adult.

Habitat.—The types are from Hope, Ind. Galls collected on burr oak by C. J. Casey showed the bouncing when received at Washington June 26, 1923. These galls were placed in rearing and adults were cut out of them on December 5 and 12, and March 26. The writer had collected the galls in four different years at Evanston and Kenilworth, Ill., but failed to rear them. At Medina,

N. Y., they were full grown by June 30. Galls were received also from Ann Arbor (Pennington), Mich., and Corinth (Barracks), Iowa. They have also been reported in literature from Missouri and Minnesota. A similar gall occurs on *Q. bicolor.*

NEUROTERUS FUGIENS, new species

Female.—Piceous, legs pale beyond coxae, antenna infuscated except tip of pedicel, scape, and first two segments of flagellum which are pale yellowish-white. Head coriaceous, eyes slightly protuberant, cheeks not enlarged behind eyes, malar space .4 eye with groove, antenna 13-segmented, lengths as (scape) 9:7:16:8:8:8:8:7:7:7:6:6:10, last in some specimens shows trace of subdivision. Mesonotum smooth, polished, a few short hairs on scutellum, no traces of grooves, length to width as 50:32, often collapsed. Mesopleura micro-coriaceous, mesosternum bulging prominently below. Tarsal claws fine, simple. Wing subhyaline, pubescent, ciliate, first abscissa of radius scarcely angulate, radial cell five times as long as broad, areolet reaching one-fifth way to basal, second intercubitus set at angle of about 68° to basal, cubitus reaching basal which is slightly clouded. Abdomen not as long as head and thorax, higher than long, lengths of tergites as 20:12:6:5:6:4, ventral spine short, ovipositor short, protruding horizontally. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.1, ovipositor 1.2, wing 3.9. Length, 1.3–1.7 mm. Average of 58 specimens, 1.45 mm.

Male.—Color as in female. Antenna 14-segmented, lengths of first four segments as 9:8:22:9, third not excavated, slightly bent. Mesonotum length to width as 55:35. Abdomen triangular in side view, almost as long as head and thorax, petiole pale. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.6, wing 3.4. Length, 1.6–2.05 mm. Average of 17 specimens, 1.79 mm.

Types.—Cat. No. 27183, U.S.N.M. Type female, allotype, 9 male and 29 female paratypes. Paratypes in Field Museum, American Museum, and Stanford.

Host.—Quercus macrocarpa.

Gall (fig. 29).—A lens-shaped thickening in the parenchyma of a leaf always adjacent to a vein. Single or more or less confluent in a row. Most conspicuous from the lower side where rose-red hairs show against its translucent white background. On upper surface showing a very slight swelling only and only a slightly lighter green color. Exit hole above where wall is thinnest. Causes wrinkling and deformation of the leaf if numerous. Occurs in spring when young leaves are about one-third grown.

Habitat.—The type material is from galls collected on *Q. macrocarpa* at Willow Springs, Ill., May 24, 1919, when some of the cells contained larvae and others pupae. The adults issued by May 30. The galls were seen also at Evanston.

Biology.—On June 16, 1916, empty galls on burr oak were seen at Evanston and on the same stump sprouts were found half-grown galls of the *saltarius* described above suggesting that this is the alternating generation of that species. On May 28, 1916, at Evanston on the small lower branches from the trunk of a tree of *Q. bicolor* these galls were found, some with exit holes and others containing pupae. Adults apparently from these galls were seen ovipositing on the under side of the leaves which were then about 3 inches long. Unfortunately none of the flies was preserved. Old leaves on the ground bore evidence of the presence of the jumping gall the previous fall. Experimental proof of this suggested life history is needed as the adults seem to go in the subgenus *Diplobius*, created for species whose alternating galls are practically identical.

NEUROTERUS UMBILICATUS Bassett

Galls on *Quercus bicolor*, agreeing with Bassett specimens, were collected at Washington, D. C., on September 23, 1923. No adults were reared, as some of the galls at least still contained larvae June 1, 1924. In late October, 1924, William Beutenmueller collected galls at Tenafly, N. J., and sent some to the writer for rearing. Up to January 1, 1926, he had reared nothing from the thousands of galls in his breeding cages, some indoors and some out, nor has the writer succeeded in rearing the adults. Galls were also seen at Ithaca, N. Y.

NEUROTERUS VERNUS Gillette

The writer has found galls of this species only once, and at Moline, Ill. The adults had all emerged before July 21.

NEUROTERUS VESICULA (Bassett)

The galls of this species were described as starting their development in the fall, maturing quickly in the spring, the adults emerging about the time the oak leaves begin to expand. The writer has no evidence to show that this succulent gall develops partially in the fall, but they do occur and become full-grown before the buds start in the spring, the adults emerging either before or just as the buds open. They have been noted on *Quercus alba*, from which the species was described, at Ravinia, Ill., containing both pupae and adults on April 24, 1915, the adults beginning to emerge April 29. Fort Sheridan galls contained pupae May 12, 1917, adults emerging May 18. In 1920 galls contained pupae at Cherrydale, Va., on

April 11; and at Chevy Chase, Md., on April 18. At Washington adults were emerging March 27, 1921, and in the late season of 1924 on April 26. In emerging the flies chew out a round piece, which often remains as a hinged lid. On *Q. montana* galls were seen at Washington, with flies emerging April 22, 1923. On *Q. bicolor* the galls were common at Evanston, Ill., being noticed as early as March 28, 1909, and March 27, 1910 (adults emerged and died in jar before April 20). In 1912 emergence was in late April, only one fly being reared from galls collected May 6. In 1913 galls were collected on April 15, some already showing exit holes, adults emerging by April 27. While gathering the galls an adult thought to be of this species was observed ovipositing in a bud. On *Q. macrocarpa* galls were found at Evanston May 1, 1913, and on April 27, 1915, three empty ones from which adults had recently emerged, and near by two adults perhaps from these galls were seen ovipositing in buds. Similar galls occur at Washington on *Q. stellata*, the flies emerging March 27–30, 1921, and April 25–29, 1924.

DIPLOLEPIS ACRASPIFORMIS, new species

Female. Almost all black, legs and some other parts brownish. Head coriaceous; from above transverse, as broad as thorax, cheeks broadened behind eyes, occiput slightly concave; from in front facial quadrangle one and four-tenths times as broad as high, malar space half eye without groove, antenna 13-segmented, lengths as (scape) 12:6:21:18:15:14:12:10:8:7:6:6:12. Thorax covered with short uniformly distributed white hairs not hiding sculpture. Mesoscutum not quite smooth, parapsidal grooves deep, narrow, smooth, percurrent, no median. Disk slightly rugose, with transverse furrow at base. Carinae on propodeum weak, curved, neck smooth. Mesopleura smooth. Hind tarsus shorter than tibia, segments as 25:12:8:5:13 (with claw 20). Claws with tooth. Wing subhyaline, pubescent, ciliate, veins brown, first abscissa of radius arcuate, second curved and swollen at free end which does not quite reach wing margin, areolet reaching nearly one-fourth way to basal, cubitus reaching basal, a cloud on break in anal, one above basal third of cubitus on first abscissa of radius and two in the apical cell, the lower one somewhat elongated, dividing the cell into thirds. Abdomen longer than head and thorax, length to height to width as 38:29:23, lengths of tergites along dorsal margin as 32:6:5, sides of second pubescent at base, dorsal margin straight and hind margin very oblique, ventral valves oblique, not protruding, ventral spine hairy, broad, abruptly tapering toward apex. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.5, wing 4.6, ovipositor 1.9. Length, 2.7–3.6 mm. Average of 12, 3.18 mm.

Type.—Cat. No. 27184, U.S.N.M. Type and 4 paratypes. Paratypes at American Museum, Field and Stanford.

Host.—*Quercus undulata* and *Quercus toumeyi.*

Gall (fig. 30).—Globular, spiny, single on under side of leaf on midrib in fall, monothalamous, 7–10 mm. in diameter. The wall of the gall is half a millimeter thick, hard and crystalline, covered with yellow spines 2.5 mm. long with swollen bases half a millimeter in diameter which are pinkish in color and polygonal by mutual pressure in cross-section. When detached a rosette of single-celled short colorless hairs is found about the base of each spine. The exit hole, 1.2 mm. in diameter is in the side of the gall. It is similar in structure to some of the *Acraspis* galls in the east.

Habitat.—The type is selected from galls collected November 7, 1921, in Blue Canyon west of Socorro, N. Mex., the flies being cut out of the galls a few days later. Paratypes are from Nogal Canyon south of Socorro, the flies emerging December 31 and January 13. Other paratypes are from Hackberry, Ariz., the flies having emerged and died before February 14. All the above were on *Q. undulata.* One paratype is from *Q. toumeyi*, Patagonia, Ariz., the fly emerging December 31. Galls were seen on *Q. undulata* at Ashfork, Ariz., also and in the Burro Mountains, N. Mex.

DIPLOLEPIS AGGREGATA, new species

Female.—Reddish-brown; eyes, anterior, and lateral lines, meso- and metapleurae and parts of abdomen black. Head transverse, narrower than thorax, pubescent, occiput concave, cheeks broadened behind eyes and margined, vertex rugose. Facial quadrangle broader than high, malar space one-third eye, without groove. Antennae 14-segmented, lengths as (scape) 18 (width 11) : 8 : 38(7) : 40 : 33 : 29 : 24 : 21 : 17 : 13 : 11 : 10 : 9 : 10(6), flagellum gradually tapering to apex. Sides of pronotum rugose, hairy. Mesoscutum smooth, shining, covered with setigerous punctures but pubescence not dense enough to hide sculpture. Parapsidal grooves deep, smooth, percurrent, separation behind not three times width of a groove, no median, lateral lines bare, prominent, anterior lines narrower, parallel. Scutellum coarsely rugose, margined on sides, disk rather flat, two pits at base, covered with erect pubescence. Spiracular areas of propodeum smooth, the usual carinae diverging below and suddenly constricting on to the reticulate neck, enclosed area somewhat reticulate. Mesopleura smooth below the broad striate longitudinal depression. Wing pubescent and ciliate, the veins heavily clouded, a group of connected spots in distal part of third cubital cell and a diffused cloud at its base under the radial cell, a faint cloud under the areolet, clouded also about break in the anal vein and in basal half of costal cell; areolet reaching one-fifth way

to basal, cubitus reaching basal below middle, its basal half heavier. Radius very heavy, first abscissa angled, second strongly curved toward wing margin in distal half, radial cell twice as long as broad, partially open at base and apex as well as on margin. Hind tarsus two-thirds as long as tibia, its segments as 47:20:12:7:20 (with claws), claw with a weak tooth at base. Abdomen longer than head and thorax, length to height to width as 58:33:22, obliquely placed, knife-like on ventral margin, the ventral spine unusually long and tapering, pubescent, as long as hind tarsal segments 1–4. Second tergite occupying nearly or quite all of dorsal margin, its ventral edge forming an angle of 45°, with pubescent area on each side at base. Using width of head as a base the length of mesonotum ratio is 1.6, antenna 3.2, wing 4.5, ovipositor 3.4.

Range in length, 4.0–5.5 mm. Average of 7 pinned specimens, 4.87 mm.

Separated from other spotted winged species in the genus by the long ventral spine.

Type.—Cat. No. 27185, U.S.N.M. Type and 2 paratypes. Paratypes at Field Museum and Stanford.

Host.—Quercus arizonica.

Gall (fig. 3).—Globular oak apples, up to 35 mm. in diameter, occurring in summer in clusters of sometimes as many as 12 on a twig at apex of previous season's growth. Each has an abrupt slender pedicel and usually only 2–4 galls in the cluster become well developed. The fresh galls are creamy white with a reddish blush on one side and spotted with numerous small red spots. Later they become yellowish and are often covered with a bluish bloom. The central cell is supported by a dense mass of fine silky radiating fibers and the wall is thick (0.7 mm.), seven times as thick as that of the smaller unspotted leaf-gall apple of the same region, *D. bella.*

Habitat.—The type fly is one of four bred from galls collected in the Santa Catalina Mountains, Ariz., on "white oak" (*Q. arizonica*) by M. Chrisman and sent in under Hopkins U. S. No. 13643*m*. The flies were reared November 22 and 27, 1918. Two paratypes from the Huachuca Mountains are from galls collected in Bear Canyon on *Q. arizonica* by Ed Jacot, September 28, 1919, and the flies issued before December 3. One paratype is from a gall collected on the same oak by the writer in the Chiricahua Mountains, November 26, 1922. The fly had already chewed its way out of the inner cell and was crawling about among the radiating fibers. It remained alive in a pill box without attention until some time after December 31. The writer has collected galls in Arizona at Oracle and in the Sabino Basin in the Santa Catalinas, and in the Mule, Huachuca, Tumacacori, and Santa Rita Mountains. The galls are even more common on *Q. oblongifolia* and at Patagonia were seen on *Q. toumeyi* but no

flies were reared from either host. Morrison sent galls to Washington in 1882 from Fort Grant and Hubbard sent galls from the Chiricahua Mountains in 1897.

DIPLOLEPIS AMPHORA, new species

Female.—Red, darker on abdomen and between parapsides in front. Head coriaceous, from above scarcely broadened behind eyes, occiput not concave; from in front pubescent on face, facial quadrangle one and one-fourth times as broad as high, malar space .4 eye without groove, antenna 14-segmented lengths as (scape) 10:6:11:10:9:8:7.5:7.5:7:7:7:6:5.5:8. Sides of pronotum pubescent. Mesoscutum broader than long, shining, smooth behind, coriaceous and with setigerous punctures anteriorly, parapsidal grooves deep, smooth, narrow, percurrent. Disk of scutellum smooth above, rugose behind, sides bounded by straight lines diverging behind, groove at base indistinctly divided into two pear-shaped pits. Carinæ on propodeum strongly curved, neck rugose. Mesopleura smooth. Tarsal claw with a weak tooth. Wing ample, hyaline, pubescent, ciliate, first abcissa of radius arcuate with slight cloud on upper half, second nearly straight, radial cell nearly four times as long as broad, areolet reaching one-sixth, cubitus two-thirds way to basal. Abdomen as long as head and thorax, lengths of tergites along dorsal curvature as 62:13:12:3:1:4, second pubescent at base, its hind margin oblique, ventral spine slender, in side view about six times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.6, ovipositor 2.4, wing 5.0. Length 1.4–2.2 mm. Average of 31, 1.85 mm.

Type.—Cat. No. 27186, U.S.N.M. Type and 9 paratypes. Paratypes at American Museum, Field, Stanford, and Philadelphia Academy.

Host.—Quercus undulata.

Gall (fig. 31).—A hollow cylinder, sessile at base, swollen more or less in the middle and tapering to the apex which is contracted to a small hole leading into a deep cavity in the bottom of which and in the basal third of the gall is the thin-walled larval cell below which a small cavity leads to the pedicel. Red or brownish, 4–5 mm. high by 3 mm. in diameter, the hole at apex about 1 mm. in diameter. Occurs in fall and drops with the leaves, usually only one or two on a leaf near the edge on under side.

Habitat.—The type is selected from material collected on *Q. undulata* at Tijeras, N. Mex., November 1, 1921, when some of the galls contained pupae and others adults. Paratypes are from *Q. undulata* in Blue Canyon west and Nogal Canyon south of Socorro, the living flies cut out of the galls January 3, 1922. Other paratypes are from

the same host at Hillsboro, the flies cut out November 16. Paratypes also are from Prescott, Ariz., (host not recorded), the galls collected April 13, 1918, the flies emerging before April 20 (Hopkins U. S. No. 15617*k*). The galls have been collected on *Q. undulata* at the "breaks" south of Bard, N. Mex., (E. E. Goddard), and at Ashfork, Ariz. The writer has collected what he takes to be galls of this species on *Q. grisea* at Magdalena, N. Mex.; on *Q. arizonica* at Bisbee and Oracle, Ariz.; and on *Q. oblongifolia* at Nogales, Patagonia, and in Huachuca and Santa Catalina Mountains, Ariz.

DIPLOLEPIS ATRIMENTA (Kinsey)

This species was described from imperfect specimens from galls on *Q. douglasii* from Three Rivers and Redding, Calif. The writer has collected the galls on two other California oaks also: on *Q. douglasii* at Three Rivers, Kaweah, Bagby, Placerville, Oroville, Red Bluff, Shasta, Ukiah, Lakeport (flies emerging May 12), Cloverdale, Calistoga, St. Helena, Mt. Diablo, Stanford University (flies emerged May 1–8), Los Gates, Paraiso Springs, Bradley, Jolon, Paso Robles (flies emerged April 25), Santa Margarita, and Lebec; on *Q. lobata* at Los Gatos, Stanford University, Lakeport, and Red Bluff; on *Q. dumosa* at Paso Robles, Jolon (flies emerged April 25) and Paraiso Springs. The galls are sometimes attached to the staminate flower axis as well as to leaves.

Miss Egbert reared adults of this species in April, 1917, and included a description in her manuscript thesis presented at Stanford University in May, 1917.

DIPLOLEPIS BELLA (Bassett)

Cynips bella BASSETT, Canad. Ent., vol. 13, 1881, p. 93.
Holcaspis maculipennis GILLETTE. Canad. Ent., vol. 26, 1894. p. 236.

H. maculipennis was described from a single specimen from the west slope of the Organ Mountains in New Mexico. Without seeing this type Beutenmueller and Fullaway have erroneously determined a large oak apple on *Quercus garryana* from Oregon and northern California as this species. This has since been described as *Cynips mirabilis* Kinsey (see p. 64). The writer has compared the Gillette holotype of *maculipennis* with a Bassett type of *bella* in the National Museum and finds they are the same. Because of the percurrent parapsidal grooves and very oblique hind margin of the second tergite Mayr, in 1881, placed the species in *Dryophanta*—now known as *Diplolepis*.

This species, described from an unknown oak from Tucson, Ariz., has been reared by the writer from galls on *Quercus arizonica*, *toumeyi*, *grisea*, and *undulata*, and the galls found on *oblongifolia*

and *reticulata*. Galls were seen in the Santa Catalina Mountains at Oracle and in Sabino basin, in the Santa Rita, Tumacacori, Patagonia, Huachuca, Mule, and Chiricahua Mountains, and at Nogales, Bisbee, Prescott, Hackberry, Ashfork, and Williams, Ariz. In New Mexico they were seen in the Burro Mountains, at Fierro, Kingston, Hillsboro, Nogal Canyon, Magdalena, Blue Canyon near Socorro, and in Sandia Mountains at Abo Pass and Tijeras. The galls were nearly full grown on *arizonica* in the Huachucas on July 9, and at Hackberry on *undulata* contained pupae on October 6. At Tijeras they were common on *undulata*, and on November 1 contained adults just beginning to emerge. A lot of flies cut out on that date lived in a pill-box without attention until December 30, and three were still living on January 12. Few of the galls were parasitized here. In the Chiricahuas only six adults were secured by opening 65 galls, and in the Santa Ritas only one in fifty contained a producer.

DIPLOLEPIS BREVIPENNATA (Gillette)

This species, whose type locality is Manitou, Colo., seems to be very common on all the oaks in the region of the Spanish Peaks. It occurs on every type of oak found about Las Vegas Hot Springs, and extends as far south as the Sandia Mountains. In the Garden of the Gods on October 4, 1921, galls on *Quercus gambelii* contained both pupae and adults. At Wetmore the galls were common, and on October 6 contained adults ready to emerge which were found dead (and others living) in the box when the material was examined on December 31. Galls sent to Washington (Hopkins U. S. No. 15635*a*) gave flies October 31, November 15, and January 10. At the Alvarado ranger station near West Cliff the galls were rare. Adults were chewing out of the inner cell at La Veta on October 10 and could be found among the fibers. At Trinidad galls were seen on *Q. fendleri*. In New Mexico the galls were seen at Raton, Wagon Mound, Shoemaker, Glorieta, and at Tijeras a few occurred on *fendleri* and *grisea* and one gall was found on the same bush of *undulata* that bore the similar galls of a fully-winged species *Diplolepis bella* (Bassett). This is the most southern point where the writer found the one and the most northern locality for the other.

DIPLOLEPIS CAEPULA, new species

Female.—Reddish-brown, abdomen darker behind. Head coriaceous; from above as broad as thorax, almost semicircular in outline, occiput not concave, cheeks slightly broadened behind the eyes; from in front facial quadrangle one and two-tenths times as broad as high, malar space one-third eye without groove, slight median ridge below antennae, antenna 13-segmented, lengths as (scape) 10:7:

14:12:11:10:9:8:8:8:7:7:11. Scattered short white hairs on sides of pronotum, on mesoscutum and scutellum. Mesoscutum coriaceous, shining, parapsidal grooves deep, smooth, percurrent. Disk of scutellum smooth and bare in center, rugose behind, its sides bounded by diverging straight lines, a transverse furrow at base indistinctly showing two smooth pear-shaped pits. Carinae on propodeum arcuate, enclosed area broader than high, neck rugose. Mesopleura smooth. Tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, first abscissa of radius arcuate, areolet and cubitus faint. Abdomen as long as head and thorax, lengths of tergites along dorsal margin as 55:14:2, second pubescent on sides at base, hind margin oblique, ventral spine slender, in side view five times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.5, ovipositor 3.0, wing 4.6. Range in length 1.5–2.1 mm. Average of 69 specimens 1.70 mm.

Type.—Cat. No. 27187, U.S.N.M. Type and 29 paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus undulata.

Gall (fig. 32).—Shaped like a small onion, tan-colored, single or scattered in small numbers on under side of leaf in the fall, persisting on the leaf through the winter. The basal third of the sessile gall is beset with long straight single-celled hairs which are mostly reflexed toward the leaf surface. The conical apex is often lop sided and an opening at the end leads into a thin-walled cavity in which are a few scattered hairs and in the base of which is the transversely placed thin-walled larval cell in the very base of the gall. Inside the larval cell at the pedicel is a thin white disk.

Habitat.—The type is selected from a series from galls collected November 14, 1921, near Hillsboro, N. Mex., the flies emerging April 5–25, 1922. Paratypes are from Tijeras, N. Mex., and of the adults cut out of the galls on November 1 some lived in a pill box until December 28. Other paratypes are from Blue Canyon west of Socorro, adults being cut out of the galls on January 2. The galls were seen also at Hackberry, Ashfork, and Williams, Ariz. Similar galls were seen on *Q. grisea* at Magdalena, N. Mex.

DIPLOLEPIS CAPILLATA, new species

Female.—Black; mandibles, base of antennae, legs and ventral spine brownish. Head coriaceous, vertex bare and shining; from above transverse, as broad as thorax, scarcely broadened behind eyes; from in front facial line .6 transfacial and area one and four-tenths times as broad as high, malar space .4 eye without groove, radiating ridges on either side of clypeus, antenna 14-segmented, lengths as (scape) 10:6:12:11:10:8:7:7:7:6:6:6:6:10, the last

six infuscated and forming a slight club. Sides of pronotum dull with fine setigerous punctures. Mesoscutum microscopically coriaceous and polished except where sparsely pubescent anteriorly, parapsidal grooves deep, smooth, percurrent, widely separated behind, no median. Scutellum finely rugose, transverse groove in front limited laterally and opening on to disk which is smoother anteriorly. Carinae on propodeum straight, diverging slightly below and slightly angled near the neck. Mesopleura polished. Hind tarsal segments as 23:8:5:4:11 (with claw 16). Claws with tooth. Wing hyaline, pubescent, ciliate, veins brown but not heavy, second abscissa of radius heaviest, slightly angled, areolet reaching one-ninth way to basal, radial cell four times as long as broad. Abdomen longer than head and thorax, oval and oblique in side view, longest length to height to width as 26:21:12, lengths of tergites along dorsal curvature as 34:12:8:10:15:7, second with pubescent areas at base and hind margin at angle of about 75°, ventral valves oblique, tips projecting, ventral spine long, slender, in side view horizontal, nine times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.25, antenna 2.3, wing 4.4 Length, 1.9–2.4 mm. Average of 6 specimens, 2.2 mm.

This species does not strictly belong in this genus on account of structure of propodeum and abdomen.

Type.—Cat. No. 27188, U.S.N.M. Type and four paratypes. Paratypes in American Museum, also in Field Museum and Stanford University.

Host.—Quercus alba.

Gall (fig. 4).—Cluster of 2–12 on midrib on under side of leaf in fall, usually on the lower leaves of strong sprouts from stumps. The individual galls are whitish or tan-colored, somewhat globular, 2–3 mm. in diameter, but slightly distorted by mutual pressure, covered with sparse short pubescence which does not hide the outline of the gall.

Habitat.—The type material was collected at Fort Sheridan, Ill., October 3, 1914. Nothing emerged before September, 1915, but when the breeding cage was next examined on November 2, 1915, six dead adults were found in the cage and a gall contained a full-grown larva, and a larva was found when another gall was opened June 2, 1916. The galls were also seen at Highland Park, Ill.; Kimmswick, Ironton, and Poplar Bluff, Mo.; Hot Springs and Texarkana, Ark.; Bluemont, Va., and Washington, D. C. A similar gall without the long scattered hairs was observed on *Q. montana* at Washington and Bluemont. Galls collected at East Falls Church, Va., in October, 1923, gave adults December 12, 1924. A series of eight of these averaged 3.2 mm. in length and they are included as paratypes.

DIPLOLEPIS CAROLINA (Ashmead)

Described from two adults from Asheville, N. C., from galls on *Quercus alba*. The writer reared two flies which agree with the types from galls collected on *Q. stellata* at Ironton, Mo. in October, 1917, the flies emerging June 1, 1918. The galls occur in clusters of 2–4 on the midrib and nearly always on *upper* side of the leaf but sometimes on the lower. They are 5–6 mm. in diameter, with a smooth surface just visible with hand lens between clumps of stellate hairs. The galls were seen at Hoxie, Hot Springs, and Texarkana, Ark.; Palestine, Houston, Boerne, College Station, and Arlington, Tex.; Madison and Ocala, Fla. What seems to be the same gall occurs at Boerne and Austin, Tex., on shin oak, *Q. breviloba*, and on *Q. chapmani* at Carabelle, Clearwater, St. Petersburg, and Daytona, Fla.

DIPLOLEPIS CAVA, new species

Female.—Red, anterior and lateral lines and eyes black, middle of face, metanotum, parts of mesopleura, dorsal portion of third tergite, and adjacent parts of second more or less infuscated. Head from above as broad as thorax, cheeks not broadened behind eyes, vertex granulate; from in front broader than high, malar space .43 eye with faint striæ, antennæ hairy, 14-segmented, lengths as (scape) 17 (width 9) :7:26(6):20:17:14:12:11:9:8:8:7:7:9 (6). Mesoscutum smooth, uniformly covered with setigerous punctures, the pubescence not dense enough to hide sculpture, parapsidal grooves deep, smooth, percurrent, anterior and lateral lines bare, smooth. Scutellum with two distinct oblique smooth pits at base, disk almost smooth in center, the rest rugose. Carinae on propodeum bowed out enclosing a smooth area broader than high. Wing pubescent and ciliate, veins brown, heavy, first abscissa of radius scarcely angled, second curved up toward wing margin in distal third and enlarged at end a little back from margin, areolet reaching about one-sixth way to basal, cubitus not quite reaching basal, a cloud in base of third cubital cell back of areolet and three groups of spots in distal end, the middle largest. Hind tibia much longer than tarsus, claws with a weak tooth. Abdomen longer than head and thorax, length to height to width as 36:29:23, lengths of tergites along dorsal margin as 104:10:3:0:0:7, hairy patches at base of second, its hind margin at angle of 45°, ventral valves oblique, ventral spine hairy, in side view four times as long as broad, broader from below than from side. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.2, ovipositor 1.8, wing 3.4. Length, 2.9–3.9 mm. Average of 9 pinned specimens 3.4 mm.

Type.—Cat. No. 27189, U.S.N.M. Type and 2 paratypes. Paratypes in American Museum, also in Field Museum and Stanford University.

Host.—*Quercus breviloba* and *Quercus laceyi.*

Gall (fig. 5).—An oak apple, 14–20 mm. in diameter, usually single on under side of leaf in fall. Reddish-brown, not spotted, wall thin, central cell supported by numerous silky fibers, a definite bundle of parallel fibers from cell to point of attachment of gall.

Habitat.—The type material was collected in October 1917, near Austin, Tex., on the shin oak, *Q. breviloba.* A gall opened November 10, contained a pupa which transformed November 26. By December 4, adults had chewed out of the inner cell and were found among the radiating fibers. The normal emergence date unknown. These galls were seen also at Boerne and Kerrville. A paratype fly came from a gall on *Q. laceyi* at Boerne, the gall containing a pupa on November 20, which transformed by December 7.

DIPLOLEPIS CENTRICOLA (Osten Sacken)

The gall of this species is a spotted oak apple usually found singly on under side of leaf of *Quercus stellata* in the fall. The writer has collected them at Ironton and Poplar Bluff, Mo.; Hoxie and Texarkana, Ark.; and Tuskahoma, Okla. Ashmead collected galls at Asheville, N. C., and J. Angus at West Farms, N. Y. Galls at Ironton contained adults November 14 and some had already chewed their way out of the inner cell. Some emerged November 27, and December 8. Galls at Hoxie contained pupae October 10, and adults November 17. At Washington adults were found inside the galls October 9, and 20, and on November 1, some had chewed out of the inner cell.

DIPLOLEPIS CINEREAE (Ashmead)

Dryophanta cinereae ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, pp. 144 and 129.

Andricus (*Callirhytis*) *saccularius* BASSETT, Trans. Amer. Ent. Soc., vol. 17, 1890, p. 76.

Cinereae was described as a rare species on *Quercus cinerea* at Jacksonville, Fla.; *saccularius* from *Q. coccinea* and *velutina* in Connecticut. They seem to the writer to be the same. The galls have been noticed on the following oaks also: *Q. rubra, maxima, imbricaria, marilandica,* and *phellos,* and at the following localities: Evanston, Glencoe, Ravinia, Fort Sheridan, Waukegan, Palos Park, and Moline, Ill.; North East, Pa.; East Hampton (C. R. Crosby) and Medina, N. Y.; Plummer Island, Md.; Washington, D. C.; Rosslyn and Waterford, Va.; Poplar Bluff, Mo.; Trinity, Tex.; Fairfax, S. C.; and Jacksonville, Gainesville, and Ocala, Fla.

Flies were emerging at Waukegan from galls on red oak, *Q. maxima* on May 27, 1911. The National Museum has a fly from Washington that emerged May 19, 1918.

DIPLOLEPIS CLAVULA (Beutenmueller)

This species was described from a series of flies in the National Museum reared from galls collected by Koebele in Sonoma and Napa Counties. The writer collected galls on *Quercus lobata* at following locations in California: Chico, Calistoga, Stockton, Kaweah, and Lebec. Dr. J. C. Bradley collected one at Napa. The galls are just starting in August and become full grown in September and should be collected in late fall for rearing.

DIPLOLEPIS DISCALIS, new species

Female.—Reddish-brown, some specimens darker than others. Head coriaceous; from above as broad as thorax, cheeks not broadened behind eyes, occiput not concave; from in front almost circular in outline, face pubescent, facial quadrangle one and two-tenths times as broad as high, malar space one-third eye without groove, antenna 13-segmented, lengths as (scape) 11:7:15:12:10:9:8:8:8:7.5:7:6:11. Mesonotum coriaceous to smooth, shining, with scattered hairs most prominent on disk, parapsidal grooves deep, smooth, percurrent, no median; disk with transverse groove at base, sides bounded by straight lines diverging behind. Carinae on propodeum arcuate. Mesopleura smooth. Tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, first abscissa of radius arcuate, radial cell four and one-half times as long as broad, areolet and cubitus indistinct, more distinct in dark specimens. Abdomen longer than head and thorax, lengths of tergites along dorsal curvature as 62:13:16:20:6:8, second pubescent on sides, hind margin not oblique, ventral spine slender, in side view five times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.6, ovipositor 3.3, wing 4.9. Length, 1.6–2.1 mm. Average of 8 specimens, 1.88 mm.

On account of the shape of the second tergite this species is not strictly congeneric with the genotype of this genus but at present there seems to be no better place to put it.

Type.—Cat. No. 27190, U.S.N.M. Type and 2 paratypes. Paratypes in American Museum, Field and Stanford.

Host.—Quercus undulata.

Gall (figs. 6 and 33).—A thin disk, 3.6 mm. in diameter on the under side of the leaf in the fall. Monothalamous, tan-colored, convex on upper surface, margin crenate, underside concave, the transversely placed larval cell occupying the full height of the gall. Exit hole on upper surface. Single or but few on a leaf.

Habitat.—Galls were collected and living adults cut out on November 1, 1921, at Tijeras, N. Mex. The galls were also seen farther south in the Sandia Mountains at Abo Pass and in Blue Canyon near Socorro and at Hillsboro.

DIPLOLEPIS DISCULARIS, new species

Female.—Black, base of antenna and legs beyond coxae brownish, face and mesonotum with scattered appressed white pubescence. Head coriaceous; from above as broad as thorax, not broadened behind eyes, occiput not concave; from in front nearly circular in outline, facial quadrangle slightly broader than high, malar space about one-third eye without groove, antenna 14-segmented, lengths as (scape) 10:6:13:10:9:8:8:7.5:7:7:6.5:6:6:8. Sides of pronotum with fine parallel ridges near tegulae. Mesoscutum high-arched, longer than broad, finely coriaceous with setigerous punctures, parapsidal grooves deep, smooth, percurrent, a short median line visible posteriorly. Disk of scutellum rugose behind, smoother above, its sides bounded by two straight diverging lines, the two large round smooth pits at base opening on to disk behind. Carinae on propodeum strongly arcuate, enclosed area narrower above, neck rugose. Mesopleura shining, smooth except for aciculate area in front. Tarsal claws with a strong tooth. Hind tarsus 2 as long as 5 (without claw). Wing hyaline, pubescent, and ciliate, veins brown, first abscissa of radius arcuate, one-ninth length of second, areolet reaching one-eighth way to basal, cubitus indistinct. Abdomen shining, longer than head and thorax, length to height to width as 75:66:35, length of tergites along dorsal curvature as 58:15:9:5:6:5, second with sparsely pubescent areas at base and hind margin at angle of about 45°, ventral spine slender, in side view eight times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.5, antenna 3.0, wing 5.7, ovipositor 4.2. Length, 1.6–1.95 mm. Average of 6 specimens, 1.86 mm.

Type.—Cat. No. 27191, U.S.N.M. Type and 2 paratypes. Paratypes at Field and Stanford.

Host.—*Quercus garryana.*

Gall (fig. 34).—Disk-shaped, about 6 mm. in diameter by 1 mm. thick, single or scattered in small numbers on underside of leaf in fall. The upper surface is slightly concave, the edge sinuate, the margin reflexed nearly to the leaf surface. The transversely placed larval cell occupies the full height of the gall. Exit hole above.

Habitat.—The type material was collected September 8, 1922, in Sequoia National Park, Calif., near the Cedar Creek checking station on the road to Giant Forest on the Kaweah form of this Oregon oak. Living flies were cut out of the galls on November 10.

DIPLOLEPIS DUBIOSA Fullaway

The writer has collected galls on *Quercus agrifolia* at Pasadena, Santa Anita (contained adults April 20, emerged April 27, 1918), Newhall, Piru, Fillmore, Ojai (adults emerging April 27, 1918, and April 16–25, 1922), Carpinteria, Montecito, Santa Barbara, Gaviota, Santa Margarita, Paso Robles, Paraiso Springs, Monterey, San Juan, Palo Alto, Berkeley (galls developing in March, flies out before May 8), and Santa Rosa, Calif.

DIPLOLEPIS EBURNEA (Bassett)

The galls of this species were described as from the leaves of an unknown oak in southern Utah. The writer has collected them on *Quercus gambelii*, *undulata*, *grisea*. They sometimes occur on young twigs as well as on both sides of the leaves. They have been observed at Garden of the Gods (Hopkins U. S. 10781*m*), Wetmore, West Cliff, La Veta, Trinidad, and Morley, Colo.; Raton, Wagon Mound, Shoemaker, Las Vegas, Hot Springs, Glorieta, Rito de los Frijoles near Buckman, Tijeras, Magdalena, and Kingston, N. Mex.; Hackberry, Ashfork, Flagstaff, Williams, and Grand Canyon, Ariz. At Wetmore the galls could have been collected by the quart on leaves of young shoots of *gambelii* and contained adults on October 6, 1921. They emerged from early December to January 14.

DIPLOLEPIS GEMULA (Bassett)

Collected galls on *Quercus alba* at Winnetka, Ill., on June 9, 1917, when most of the flies had already emerged. Galls at Ravinia contained pupae on May 23, 1919. A similar gall exists on *bicolor* and *macrocarpa* in the Chicago area and in the South on *prinus*, *stellata*, *margaretta*, and *montana*.

DIPLOLEPIS IGNOTA (Bassett)

The galls on *Quercus bicolor* are common about Evanston and Wilmette, Ill., becoming full grown by middle of September and dropping with the leaves. During the winter the woolly covering weathers away more or less exposing the tan-colored galls which in shape and size resemble a cluster of cocoons of the braconid genus *Microplitis*. They contained pupae March 10, 1909, and adults emerged April 1–15. The next spring the flies began to emerge March 24. Similar galls on *Q. macrocarpa* were noted at Evanston and Algonquin, Ill., and Nebraska City, Nebr.

DIPLOLEPIS LAURIFOLIAE (Ashmead)

This globular leaf gall with a free-rolling cell was described from *Quercus laurifolia* from "Florida", the flies emerging in March. The

types are labeled Jacksonville. The writer collected galls at Jacksonville on April 4 from which not all the adults had yet emerged. Galls were noted on *Q. phellos* at Richmond, Falls Church, Clarendon, and Alexandria, Va., and at Chesapeake Beach, Md. In Virginia the galls appear with the opening of the buds in spring and are about full grown by the middle of April when the leaves have reached about half their normal size. For rearing they should not be gathered until they contain pupae or adults. Falls Church galls gave adults May 8–15, 1920. Clarendon galls gave flies May 14–18, 1921. It is questionable whether this name should be maintained as distinct from *palustris* (Osten Sacken).

DIPLOLEPIS NOTHA (Osten Sacken)

Galls were collected at Evanston, Winnetka, Glencoe, Fort Sheridan, and Waukegan, Ill. Adults issued June 7, 1909, before June 4, 1913, June 3, 1915. At Washington, D. C., flies issued on May 18 from galls on *Q. palustris*.

DIPLOLEPIS NUBILA (Bassett)

Cynips q. nubila BASSETT, Canad. Ent., vol. 13, 1881, p. 56.
Andricus incomptus KINSEY, Bull. Amer. Mus. Nat. Hist., vol. 42, 1920, p. 306, pl. 23, figs. 17–18.

Nubila was described from an unknown oak from Mule Pass Mountains, Ariz., the galls collected in November. The writer has collected galls in several localities in Arizona and on several hosts. The species seems to be most common on *Q. arizonica* and galls were taken at Bisbee, in Chiricahua Mountains (flies emerging January 2), in Ramsey Canyon in Huachuca Mountains, at Patagonia, in Tumacacori Mountains (flies out of January 13, February 6 and 10), in Santa Rita Mountains and at Oracle in Santa Catalina Range. Galls collected at Oracle December 17, 1921, gave adults December 31, January 3, 4, 10, 12, 14, 16, 22, 23, 24, and February 6. The forest insect collection has galls from the Santa Catalinas from which adults emerged March 30, 1916. Galls on *Q. toumeyi* were collected in the Patagonia Mountains on December 12, 1921, and flies emerged January 13 and 24 and February 4. The flies from *arizonica* range from 2.6–4.6 mm. Average of 58 specimens 2.88 mm. Those from *toumeyi* average smaller but all measured were within the range of the *arizonica* series. The writer collected the galls on *Q. oblongifolia* in the Huachuca, Patagonia, Santa Rita, and Santa Catalina Mountains and at Nogales but reared no adults. The galls were noted also on *Q. reticulata* in the Santa Catalina Mountains.

Incomptus was described from two adults cut out of galls of an unknown oak at San Luis Potosi, Mexico. The writer has examined both, comparing one directly with a Basset type of *nubila*. As the

galls were collected in September it is the writer's idea that at that time the nutritive layer had not been all used up and the larva had vitality to transform into an undersized adult but not enough to chew its way out of the hard gall. Never having been exposed to light and open air it is much paler than flies that emerge normally. Had it darkened up normally the two adjacent spots near the apex of the wing might have become connected into one double one as is the case in *nubila*, a series of which shows considerable difference in the amount of fusion that has taken place in the spots, due either to fluctuating variation or to the length of time that has elapsed or amount of exposure to light since emergence from the gall. If a *nubila* wing were bleached somewhat it would present the condition seen in *incomptus*.

DIPLOLEPIS OCCULTATA, new species

Female.—Black, the tibae, tarsi, antennae, and ventral spine honey-yellow. Head coriaceous with appressed whitish hairs; from above broader than thorax but not massive, cheeks broadened behind eyes, occiput concave; from in front facial area higher than broad, malar space .3 eye without groove, antenna 13-segmented, lengths as (scape) 11 (with 5) : 9(5) : 10(4) : 9 : 9 : 9 : 9 : 9 : 9 : 8 : 8 : 7.5 : 16(5), the last with transverse groove on one side incompletely dividing it into two segments as 6:10 in length, flagellum becoming stouter and sometimes infuscated toward tip. Thorax with sparse appressed pubescence not hiding sculpture, mesonotum coriaceous, parapsidal grooves smooth, percurrent, separation behind about width of groove, no median, anterior and lateral lines distinct; disk of scutellum rugose, groove at base indistinctly separated into two smoother pits. Carinae on propodeum straight, slightly converging above. Mesopleura with bare shining spot. Tarsal claws with distinct tooth. Wings hyaline, pubescent, ciliate, veins yellowish-brown, second abscissa of radius angled, areolet reaching one-sixth, cubitus two-thirds way to basal. Abdomen shining, shorter than head and thorax, higher than long, lengths of tergites along dorsal margin as 51:10, the rest telescoped in most pinned specimens, the second but slightly pubescent on sides at base, its hind margin at angle of about 45°. Ventral spine in side view about three times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 1.8, ovipositor 2.0, wing 3.1.

Length, 1.6–2.5 mm. Average of 117 specimens, 2.19 mm.

Type.—Cat. No. 27964, U.S.N.M. Type and 38 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, California Academy, and Philadelphia Academy.

Host.—*Quercus lobata.*

Gall.—A seed-like, thin-walled cell produced inside the winter buds and usually completely hidden by the bud scales. It is 2.5–3 mm. long, slightly flattened, with a sort of scar at the blunt-pointed apex, light colored with surface slightly veined. Usually only one in a bud and excentrically placed, not injuring the growing point. If two are present the bud is usually visibly deformed. The exit hole .8 mm. in diameter is made in the side of bud through the bud scales. Wall .1 mm. thick.

Habitat.—Type locality Cottonwood, Shasta County, Calif. On December 7 at the writer's request A. W. Gambs collected small branches of the "river bottom" oak bearing twig galls of *Disholcaspis eldoradensis* Beutenmueller but the adults had all emerged. In this box of material small gall-makers were found to be emerging on January 6 and an examination disclosed these bud galls. Others emerged January 16, 20, 21, 22 and several were cut out of the galls in dissected buds. The writer has collected old buds of this oak in summer showing this characteristic exit hole at Newhall, Ojai, Santa Margarita, Paso Robles, Los Gatos, Palo Alto, St. Helena, Lakeport, Chico and Red Bluff, Calif. Similar exit holes have been noted in old buds of *Q. douglasii*, *dumosa*, *durata*, and *garryana* but no adults were reared from these hosts.

DIPLOLEPIS OPERTA, new species

Female.—Black, front tibiae and all tarsi brownish; head coriaceous: from above transverse, cheeks broadened behind eyes, occiput scarcely concave; from in front facial area wider than high, radiating ridges and scattered white pubescence about mouth, malar space .45 eye without groove, antenna 13-segmented, lengths as (scape) 10:7:11:12:9:9:7:7:7:7:7:6:12. Sides of pronotum with setigerous punctures. Mesoscutum coriaceous, anterior and lateral lines smooth, parapsidal grooves smooth, narrow, percurrent, no median, a few white hairs along grooves. Scutellum finely rugose, pits at base smooth, narrow, septum thin. Carinae on propodeum converging above. Mesopleura shining above. Claws with tooth. Wing hyaline, pubescent, ciliate, veins distinct, first abscissa of radius almost arcuate, areolet reaching one-sixth, cubitus one-half way to basal. In fresh specimens abdomen longer than head and thorax with lengths of tergites along dorsal curvature as 41:19:13:12:10; when dry but two or three tergites showing on dorsal margin, base of second slightly pubescent on sides, ventral spine unusually long and slender, in side view ten times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.3, ovipositor 4.3, wing 4.2.

Length, 1.5–2.4 mm. Average of 36 specimens, 1.95 mm.

Differs from the preceding species by having longer and more slender antennae which are black instead of brown and in having a much longer ventral spine.

Type.—Cat. No. 28056, U.S.N.M. Type and 7 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, California Academy, and Philadelphia Academy.

Host.—Quercus lobata.

Gall.—A seed-like cell hidden under the bud scales as in the case of the preceding species but broadest at the base and tapering gradually to a conical and much more pointed apex which lacks a scar. It has a smoother tan-colored surface and a much thinner wall (.05 mm). Length 2.8 mm. by 1.2 mm. in diameter near base, reaching much nearer to the apex of the bud than the preceding. Exit hole .9 mm. in diameter, in side of bud. One or rarely two in a bud.

Habitat.—Cottonwood, Calif. Reared in January and early February from same sending of material as the preceding species.

DIPLOLEPIS PALUSTRIS (Osten Sacken)

Galls were collected at Evanston, Winnetka, Ravinia, and Willow Springs, Ill.; Miller, Ind.; Onekama (T. Hatfield), Mich.; Cedar Rapids (J. H. Scott), Iowa; East Hampton (C. R. Crosby), N. Y.; Plummer Island and Chesapeake Beach, Md.; Falls Church, Alexandria, Rosslyn, and at Apple Orchard Camp in Bedford County, Va.

The young galls appear with the leaves in the spring being as large as a pea when the leaves are an inch and a half long. Seventeen days later adults were emerging. In the Chicago area the following emergence records indicate the variation from season to season: May 31, 1906, June 19, 1907, May 28, 1908, June 12, 1909, May 26, 1911. The galls sometimes occur on the axis of the staminate flowers.

Brodie collected galls on red oak at Toronto, Canada, where adults emerged July 2–10, 1888 and June 6–9, 1889.

DIPLOLEPIS PEDUNCULATA (Bassett)

The galls of this species were collected on *Quercus coccinea* at Winnetka, Glencoe, Ravinia, Fort Sheridan, and Waukegan, Ill., and on *Q. maxima* at Rosslyn, Va., where they seemed to be full grown by May 16. Crosby collected them at East Hampton, Long Island. The writer reared adults from Winnetka galls on June 24.

DIPLOLEPIS POLITA (Bassett)

Galls have been seen at Tuxedo (F. V. Rand), Md.; Washington, D. C.; Falls Church, Va.; Jacksonville, Daytona, Ocala, and Gainesville, Fla.; Clyde, Sisco, Eastland, Ranger, Mingus, Gordon, Santo, Weatherford, Mineola, Palestine, and Trinity, Tex.; Hugo and Tus-

kahoma, Okla.; Koshkonong (R. L. Barrett) and Ironton, Mo. At Falls Church overwintering galls gave flies April 2 (Hopkins U. S. No. 11324[a]). Texas galls sent to Evanston, Ill., began to give adults April 25.

DIPLOLEPIS PULCHRIPENNIS (Ashmead)

Described as from *Quercus undulata*, the writer has collected galls and reared flies which agree with the type on *Q. undulata* and *grisea* and collected what seem to be the same galls on *arizonica*, *oblongifolia*, *toumeyi*, and *reticulata*. Galls were collected at the "breaks" south of Bard (E. E. Goddard), Wagon Mound, Las Vegas Hot Springs, Glorieta, Tijeras, and Abo Pass in the Sandia Mountains, near Socorro, Magdalena, Nogal Canyon, Hillsboro, Kingston, and in the Burro Mountains in New Mexico; at Williams, Prescott, Oracle, Patagonia, and in the Santa Rita and Chiricahua Mountains in Arizona. At Las Vegas Hot Springs galls were collected on October 17 when flies were just beginning to emerge. A lot were out and had died by January 2 and a few more emerged by January 13.

DIPLOLEPIS RYDBERGIANA (Cockerell)

The type fly and gall of this species are in the National Museum. The writer collected galls at the type locality, Las Vegas Hot Springs, N. M., in October, 1921, and cut out living flies January 2. Galls sent east for rearing gave flies December 31, January 4, 20, February 1 and 6, the flies coming out in largest numbers on last date. From galls collected at Shoemaker on October 23, 1922, flies emerged and were alive on February 16, 1923. Galls were collected at Wagon Mound also. They are saddled on the midrib on the under side of the leaf. The type fly measures 2.8 mm. The series of reared specimens ranges from 2.5–3.8 mm. Average of 88 specimens, 3.16 mm.

DIPLOLEPIS SESSILIS, new species

Female.—Honey-yellow, abdomen darker behind, eyes black. Head from above transverse, as broad as thorax, cheeks not broadened behind eyes; from in front face pubescent, facial quadrangle slightly broader than high, malar space three-eighths eye without groove, antenna 14-segmented, lengths as (scape) 12 : 7 : 16 : 15 : 14 : 13 : 11 : 10 : 8 : 8 : 7.5 : 7.5 : 7 : 10. Sides of pronotum pubescent. Mesoscutum smooth, shining, bare except for a row of hairs along each groove. Parapsidal grooves narrow, deep, smooth, percurrent. Anterior and lateral lines indistinct. No median. Transverse groove on scutellum divided into two pear-shaped pits. Disk with scattered hairs and slightly rough behind, its sides bounded by straight lines diverging behind. Carinae on propodeum diverging below and angled. Hind

tibia longer than tarsus, whose segments are as 26:9:6:5:10 (with claw 14), claw with tooth. Wing subhyaline, pubescent, ciliate, veins brown, first abscissa of radius clouded above its angle, second nearly straight, radial cell three and three-tenths times as long as broad, areolet reaching one-fifth way to basal, cubitus reaching basal. Abdomen almost as long as head and thorax, lengths of tergites along dorsal margin as 65:4, rest hidden, second pubescent at base and hind margin at angle of about 45°, ventral valves oblique, protruding, ventral spine slender, in side view six times as long as broad, ovipositor curved at the tip. Using width of head as a base the length of mesonotum ratio is 1.5, antenna 2.9, wing 5.0, ovipositor 3.2. Length, 2.1–2.5 mm. Average of 12, 2.4 mm.

Type.—Cat. No. 27192, U.S.N.M. Type and 4 paratypes. Paratypes at American Museum, Field, and Stanford.

Host.—Quercus arizonica.

Gall (figs. 7 and 35).—Cylindrical with a deep broad cup at apex, dark red, attached on under side of leaf in the fall, falling with the leaf. Usually only one or two on a leaf. The galls measure up to 5 mm. high and 5 mm. in diameter at upper end. The lower end with a sharp flaring rim is sessile on the leaf surface, the upper half dilated, not so smooth, brownish, often inrolled at top, giving the gall somewhat the appearance of a sea anemone. The basal half of the gall is occupied by a centrally placed conical cavity, above which and immediately below the floor of the cup is an excentrically placed larval cell which is cut transversely, if at all, when the gall is split lengthwise.

Habitat.—The type locality is the Santa Catalina Mountains, Ariz., where galls, then containing pupae, were collected on *Q. arizonica* on December 21, 1921, at an elevation of 5,700 feet near the Daily camp on the east side of the range. Living adults which would probably have emerged in the spring were cut out of the galls on January 13. The galls were also seen on the same host at Oracle and in Santa Rita, Huachuca, and Chiricahua Mountains, Ariz. Apparently the same galls were seen on *Q. oblongifolia* in the Santa Rita and Tumacacori Mountains.

DIPLOLEPIS SPLENDENS (Weld)

The writer collected galls of this species November 7, 1921, in Blue Canyon west of Socorro, N. Mex., on *Quercus undulata*, adults emerging April 5 and 26. More were taken near Magdalena on *Q. grisea*, the galls containing adults in December, flies emerging March 9, April 6, and many April 26. They were also taken on *Q. undulata* in Nogal Canyon south of Socorro and at Kingston on *Q. grisea*. The species was previously known in the United States only from *Q. grisea* and from Arizona.

DIPLOLEPIS SULFUREA, new species

Female.—Red, the eyes, vertex, clypeus, anterior and lateral lines, transverse groove, coxae and distal part of abdomen black. Head as broad as thorax, cheeks not enlarged behind eyes, occiput not concave, vertex coriaceous; from in front face pubescent, facial quadrangle higher than broad, malar space one-third eye without groove, antenna 13-segmented, lengths as (scape) 8:5:9:8:7:7:6:6:6:6:5.5:5:10. Mesoscutum smooth with scattered setigerous punctures, parapsidal grooves narrow, smooth, deep, percurrent. Disk of scutellum pubescent, slightly rough behind, bounded on sides by straight lines slightly diverging behind, transverse grooves at base smooth. Carinae on propodeum faint, strongly curved, spiracular areas smooth, pubescent. Mesopleura smooth. Tarsal claw with a tooth. Wing large, hyaline, pubescent, ciliate, veins brown, first abscissa of radius slightly clouded, second long and almost straight, radial cell over four times as long as broad, areolet reaching one-fifth way to basal, cubitus indistinct. Abdomen as long as head and thorax, lengths of tergites along dorsal curvature as 67:11:6:0:2:5, second pubescent at base and hind margin very oblique, ventral spine slender, five times as long as broad in side view. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.3, wing 4.5, ovipositor 2.7. Length 1.8–2.1 mm. Average of 3 pinned specimens, 1.95 mm.

Type.—Cat. No. 27193, U.S.N.M. Paratype at Stanford.

Hosts.—*Quercus arizonica*, *grisea*, *oblongifolia*.

Gall (figs. 8 and 36).—A hollow cone, sessile at base and open at apex, densely covered with long sulphur-yellow spines, on under surface of leaf, single or scattered, sometimes as many as nine on a leaf but usually only one to three. The cone is up to 7 mm. high by 4 mm. in diameter at base, with a crystalline surface, white or rosy when growing, the spines up to 4 mm. long and often rosy at the tip. The larval cell lies transversely just below middle of gall and below it is a small obconical cavity reaching to point of attachment. The lower part of the large distal cavity above larval cell is constricted off by a narrow circular shelf. Occurs in the fall dropping only with the leaf.

Habitat.—The type fly is selected from adults cut from galls on *Q. arizonica* collected by Ed Jacot September 28, 1919, in Bear Canyon in the Huachuca Mountains, Ariz. The flies were alive when cut out on December 4 and would probably have emerged in the spring. One paratype is from a gall on *Q. grisea* collected at Ashfork in October, 1922. The writer has also taken the galls on

Q. oblongifolia at Nogales and Patagonia and on *Q. arizonica* at Oracle, Patagonia, Ramsay Canyon in the Huachuca Mountains and at Bisbee.

DIPLOLEPIS TECTURNARUM (Kinsey)

Andricus tecturnarum KINSEY Bull. Amer. Mus. Nat. Hist., vol. 42, 1920, pp. 312, 384, pl. 25, figs. 30–33.

This species was described from an unknown oak from San Luis Potosi, Mexico. The writer found the galls very abundant on *Q. undulata* at Tijeras, N. Mex., in April, 1918, and again on November 1, 1921 (adults emerging by hundreds February 20 to March 9, 1922). Galls on this oak were seen also in Blue Canyon and Nogal Canyon near Socorro, at Hillsboro and Kingston, in the Burro Mountains and in Arizona at Hackberry and Ashfork (flies emerging February 14). The galls were also very common on *Q. grisea* at Magdalena, N. Mex., in November, 1921, the flies emerging in large numbers February 20 to March 8. Galls were seen at Williams, Ariz., also. One cluster of the galls was collected on *Q. gambelii* near Magdalena, flies emerging February 4–20. At Oracle, Ariz., a few galls occurred on *Q. arizonica*, adults emerging March 9. Here the galls are hard to distinguish from *nubila* when seen up in the tree, but in hand the difference in structure is at once apparent. At Las Vegas Hot Springs galls on an unknown oak contained pupae on October 12 and adults emerged January 13, February 20, and March 8. At Shoemaker, Rowe, Glorieta, Tijeras, and Magdalena galls were seen on what may have been *Q. fendleri*. The galls were also seen at Fierro and in Arizona in the Huachuca and Patagonia Mountains and about Prescott.

Only a badly dilapidated paratype has been available for direct comparison of the adults. Cut from a gall collected in September over forty years before it is naturally paler than fresh specimens emerging naturally. A series of fifty measured specimens from one host and locality shows a range in size of 1.75 to 2.45 mm. Average 2.12 mm.

DIPLOLEPIS TENUICORNIS (Bassett)

This species was described from an unknown oak from the Mule Pass Mountains, Ariz. The type galls in the American Entomological Society seem to be on *Q. arizonica*. The writer collected galls on *arizonica* in December at Oracle in the Santa Catalina Mountains and reared adults in March.

DIPLOLEPIS UNICA, new species

Female.—Black; the head, antennae, tegulae, margin of parapsidal grooves, and legs more or less brownish. Head coriaceous; from

above transverse, not quite as wide as thorax, cheeks not broadened behind eyes, occiput concave; from in front broader than high, facial area one and one-fourth times as broad as high, malar space one-third eye without groove, antenna 14-segmented, lengths as (scape) 20 (width 10) : 9 : 33(5) : 24 : 20 : 19 : 14 : 12 : 10 : 9(7) : 8 : 8 : 6 : 9. Pronotum pubescent on sides. Mesoscutum shining, smooth with scattered punctures, sparsely pubescent except on broad lateral and anterior lines, parapsidal grooves deep, smooth, percurrent. Scutellum rugose, not margined behind, transverse groove at base opening on to disk behind and not sharply limited laterally. Carinae on propodeum bowed out, widely separated below but close together and parallel above. Second tarsal segment shorter than fifth, claws stout and simple. Wing dusky, all veins very heavy, second abscissa of radius angled and heavily clouded, third strongly curved and not reaching margin, stouter at end: areolet lost in cloud in some specimens, cubitus reaching basal. Abdomen not quite as long as head and thorax, lengths of the three main tergites as 27 : 4 : 3, second with sparsely pubescent patches at base and hind margin at angle of 45°, ventral valves oblique but inconspicuous, ventral spine horizontal, stouter than in *Andricus*, triangular, hairy, ovipositor short, tip straight. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.4, ovipositor 2.0, wing 4.0. Length, 2.4–3.5 mm. Average of 15 specimens, 3.0 mm.

This species is close to *D. carolina* (Ashmead) from which it is separated by its black abdomen, the longer groove at base of scutellum and more pubescent mesoscutum. Neither species strictly belongs in this genus because of the simple claws and heavy wing venation.

Type.—Cat. No. 27194, U.S.N.M. Type and 3 paratypes. Paratypes at American Museum, Field, Stanford, and Philadelphia Academy.

Host.—Quercus stellata.

Gall (fig. 9).—Spherical, 5–7 mm. in diameter, white, smooth, single, always on under side of leaf saddled on a vein so that when detached a depression (containing pedicel) and groove is left on the gall. Occurs in fall. Monothalamous. A section through a fresh gall shows a white fleshy interior containing a distinct but not free larval cell, a tinge of red or brown just under the outer layer.

Habitat.—The type material was collected at Ironton, Mo., in October, 1917, and adults emerged (in out-of-door cage near Chicago) on May 15, 1918. The writer saw galls at Poplar Bluff also, and at Hoxie, Little Rock, Hot Springs, and Texarkana, Ark; Palestine, Trinity, Cuero, Boerne, Austin, College Station, and Arlington, Tex.; and at Green Cove Springs, Fla. What seems to be the same

gall occurs on *Q. margaretta* and *lyrata* also. The Pergande collection contained a gall from Virginia and a fly which emerged April 16, 1883, determined as this species.

DIPLOLEPIS VACCINIFOLIAE (Ashmead)

Callirhytis vaccinifoliae ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 130.

This species was described from Truckee, Calif., from *Q. vaccinifolia*, the flies emerging October 16 and December 4. The writer collected galls at Tahoe City on August 7, 1922. Some of the galls were still fresh, pale yellowish-green with beautiful purple spots or streaks shaped like the branching pigment cells in a frog's epidermis, and best seen against the light. Most however were now dry, and contained either larvae or pupae. After the galls are picked and dried the adults do not seem to be able to chew through the thin outer wall. Living adults, which agree with the type, were cut out of the galls on November 10. Messrs. Burke and Hartman collected galls on *vaccinifolia* at Pine Crest, Tuolumne County, from which adults emerged December 13.

Koebele collected a similar gall on *Q. chrysolepis* in Placer County, Calif., and reared a similar fly. The writer collected galls (and cut out a living fly November 10) at Canyonville, Oreg., and also at Wolf Creek, and on the road to Oregon Caves above Holland, and also at Scott Bar, Calif.

DISHOLCASPIS BASSETTI (Gillette)

Galls of this species have been observed on *Quercus bicolor* at Evanston, Winnetka, Waukegan, and Blue Island, Ill. At Evanston the galls contained pupae on September 16, and adults emerged October 3, 1915.

Brodie collected the galls on *Q. macrocarpa* on several occasions at Toronto. In 1886 the adults emerged November 29–December 5, in all 247 specimens, all females. In a few days several oviposited in buds, thrusting the ovipositor between fold of bud scales. None survived the winter. In 1893 adults issued November 9–23, all females.

DISHOLCASPIS CINEROSA (Bassett)

The large pointed-bullet galls of this species, described from an unknown oak, occur on *Q. virginiana* and have been seen at various points in Texas: Houston, Wharton, Victoria, Cuero, Boerne, Austin, Sabinal, Kerrville, Beeville, Tiger Mills, Columbia (E. A. Schwarz), and Quincy. A tree at Wharton contained hundreds of them in October, 1917. While growing they secrete honeydew and wasps frequent them in large numbers. J. D. Mitchell reared the adults at Victoria December 5–25.

DISHOLCASPIS CONALIS, new species

Female.—Pale yellowish-red. Whole body densely covered with short silky yellowish-white pubescence except on vertex and a star-shaped dorsal spot on second tergite. Head coriaceous; from above narrower than thorax, cheeks greatly broadened behind eyes, occiput not concave: from in front facial quadrangle 1.2 times as broad as high, malar space one-third eye without groove, antenna 14-segmented, filiform, lengths as (scape) 14:9:27:22:17:16:14:12:10:10:9:8:7:15. Sides of pronotum smooth. Mesoscutum broader than long, broadly rounded in front, coriaceous with setigerous punctures, parapsidal grooves deep, smooth, reaching forward halfway, no median, anterior and lateral lines slightly darker. Scutellum with transverse groove at base, disk broader than long, rugose behind. Neck of propodeum rugose and above it are fragmentary carinae. Mesopleura smooth. Tarsal claws with a tooth. Wing slightly dusky, pubescent, ciliate, veins brown, first abscissa of radius angulate with a slight cloud above angle, free portion of subcosta reaching about halfway to margin, areolet reaching one-fifth way to basal. Abdomen as long as head and thorax, length of tergites along dorsal margin as 38:10:2, hind margin of second at angle of 45°, ventral spine short, broad, hairy, sides parallel with triangular apex, gouge-shaped in cross-section; ovipositor short, straight at tip. Using width of head as base the length of mesonotum ratio is 1.6, antenna 2.4, ovipositor 2.3, wing 4.3. Length, 2.8–4.4 mm. Average of 30 specimens, 3.65 mm.

This would run in Dalla Torre and Kieffer key to *Cynips* on account of the pubescent abdomen but with this exception it has the characters of *Disholcaspis*.

Type.—Cat. No. 27195, U.S.N.M. Type and 12 paratypes. Paratypes in American Museum, Field, and Stanford.

Host.—Quercus garryana.

Gall (fig. 37).—Conical, 10–18 mm. high, with a clasping base 8–12 mm. in diameter, the tapering apex often lopsided, single or in small clusters on small twigs in the fall. Greenish when growing and covered with dense short white pubescence which rubs off after the galls begin to harden. They start to develop late in May and mature in September. Old galls are tan-colored. The interior consists of dense cellular tissue with a transversely placed larval cell, not separable and without a distinct lining wall.

Habitat.—The type material was collected September 8, 1922, in Sequoia National Park, Calif., just above the Cedar Creek checking station on the road from Kaweah to Giant Forest. Some flies issued and died in the packet before October 1, while others died inside, not being able to chew out of the hard galls.

DISHOLCASPIS GLOBULUS (Fitch)

On *Quercus alba* these round bullet galls were seen at Glencoe, Ravinia, Glen Ellyn, and Moline, Ill.; Cedar Rapids, Iowa; Poplar Bluff and Ironton, Mo.; Tuskahoma, Okla.; Texarkana, Ark.; Troy, Ala.; Marianna and River Junction, Fla.; Bluemont, Va.; Blue Hills, Mass.; Pitman (Bradley) N. J.; Syracuse (Crosby) and East Hampton (Schradieck), N. Y.; Elyria, Ohio. On rock chestnut oak, *Q. montana* they were seen at Ithaca, N. Y.; North East, Pa.; Bluemont, Bedford County, and Falls Chuch, Va. In the Chicago area the young galls appear in July, contain pupae September 23, and adults emerge October 20–November 1. Brodie says the adults emerge at Toronto from October 12–November 1 and at once commence to oviposit in white oak twigs. Some which emerged October 17 lived until November 10 but none survived the winter. He reared about two hundred without finding a male. He received galls from Brainbridge, Muskoka, from which adults emerged at Toronto on November 5.

DISHOLCASPIS MAMMA (Walsh)

Galls on *Quercus macrocarpa* are here recorded from the following localities: Mandan (H. F. Bain), N. Dak.; Walnut Grove (C. J. W.) and Becker (L. Haney), Minn.; Evanston, New Lenox, Glen Ellyn, and Moline, Ill.; Corinth (C. Barracks), Iowa; Cedar Point, Kan.; Nebraska City, Nebr.; Surry (C. Chupp), and Waterloo, Ind.; Manistee, Mich., and Medina, N. Y. On *Q. bicolor* at Evanston, Ill. On *Q. lyrata* similar galls yielding similar adults at Hoxie and Texarkana, Ark., and Poplar Bluff, Mo.

In the Chicago area the galls start about the middle or end of July and some are full grown by end of August, adults emerging in different years from October 20 to November 10. At Poplar Bluff galls contained pupae October 8 and adults emerged November 13–December 3. Brodie found the galls at Toronto on *Q. macrocarpa*, the adults emerging in 1896 from October 17 to November 6. Some lived until November 22, but they do not survive the winter. In order to determine the next season's galls he "put 25 females in a muslin bag tied around a couple of low branches of burr oak from which the leaves had fallen on November 10 and for some days noted them ovipositing. They stood upon the tops of the buds grasping them firmly, then curving up the abdomen they pushed the ovipositor between the scales of the buds and remained a few minutes but they do not place more than one to three eggs in a bud." On May 30, 1897, he found numerous galls, the petiole or midvein beginning to bulge. By July 1 they were full grown and adults emerged July 11–17. "These galls were similar in form and texture to galls of *H. petiolicola* from white oak, contained from 3–10 cells,

the producers emerge in the same way as *A. petiolicola.* Producers sexual, sexes about equally numerous." So far as the writer is aware this is the first published indication of an alternating generation for a *Disholcaspis*—a genus whose species are all known by agamic females emerging in the late fall.

DISHOLCASPIS PATTERSONI Kinsey

The writer collected the galls of this species on shin oak, *Quercus breviloba* at Austin, Boerne, and Kerrville, Tex. Galls at Boerne contained adults October 25, adults November 13, and when galls were placed in out-of-door cage at Evanston, Ill., adults emerged November 20 and December 1. Five living flies were found in cage February 19 after six weeks without a thaw, four more March 23 and one April 22.

DISHOLCASPIS PEDUNCULOIDES, new species

Female.—Honey-yellow, distal half of antenna and abdomen reddish-brown. Head transverse, broader than thorax, coriaceous, covered except on vertex with appressed pubescence. Facial quadrangle 1.27 times as broad as high. Malar space .4 eye, without groove. Cheeks widened behind eyes. Antennae 13-segmented, flagellum filiform, lengths as (scape) 13 (width 7) : 7(6) : 16(4) : 15 : 13 : 11 : 10 : 8 : 7 : 6 : 6 : 6 : 13(4). Mesoscutum, mesopleura, and sides of prothorax smooth between the setigerous punctures. Parapsidal grooves not reaching forward halfway. No median. Anterior and lateral lines scarcely darker. Scutellum becoming rugose behind, transverse groove at base bounded laterally and with longitudinal ridges in bottom. Propodeum without usual carinae, spiracular areas smooth, two strong carinae from abdominal fossa to each hind coxa. Hind tibia longer than tarsus, hind tarsal segments as 30 : 13 : 9 : 5 : 17, claw with tooth. Wing pubescent and ciliate, radial cell three and seven-tenths times as long as broad, open slightly at base and apex as well as on margin, first abscissa of radius angled, second almost straight, areolet reaching one-fifth and cubitus two-thirds way to basal. Abdomen shows ratio of length to height to width as 23 : 25 : 15. Lengths of tergites along dorsal curvature as 50 : 16 : 4 : 0 : 9 : 13. Second with large sparsely pubescent area on each side at base, its hind margin at angle of about 80° to long axis of abdomen. Ventral spine hairy, in side view conical, twice as long as broad. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.3, ovipositor 3.0, wing 4.4.

Range in length 1.7–2.9 mm., average of 130 specimens 2.24 mm.

Related to *Disholcaspis virens* (Ashmead) from which it differs in the more uniform coloration of the thorax.

Type.—Cat. No. 27196, U.S.N.M. Type and 69 paratypes. Paratypes in American Museum, Field, Stanford, and Philadelphia Academy.

Host.—*Quercus grisea*, *undulata*, *arizonica*, *oblongifolia.*

Gall (fig. 38).—In clusters of 2–20 on the peduncle. Individual galls slender, conical, 10–12 mm. long, sharp at tip, tapering below to about 3 mm. in diameter and more or less clasping at its star-shaped base. Monothalamous, wall .3 mm. thick, exit hole in side 1.2 mm. in diameter. Colored like the bark, darker at apex.

Biology.—While growing in the late summer the galls are green but by November 1 in the Sandia Mountains they were turning brown and contained adults which emerged during last week in December and first two weeks of January.

Habitat.—The type locality is Magdalena, N. M. (*Q. grisea*) and paratype localities: Tijeras, N. M. (*Q. undulata*) and Oracle, Ariz. (*Q. arizonica*). The writer has also collected galls at Socorro, Nogal Canyon, Hillsboro, Kingston, and in the Burro Mountains, N. M.; and at Prescott, Hackberry, Nogales, Patagonia, Bisbee, and in the Chiricahua, Huachuca, Tumacacori, and Santa Rita Ranges in Arizona. The University of Arizona has galls on an herbarium specimen of oak from Ashfork, Ariz.

DISHOLCASPIS PERNICIOSA (Bassett)

The galls were observed at Trinidad, Morley, Wetmore, and Garden of the Gods, Colo.; Las Vegas, Glorieta, Rowe, and Tijeras, N. M.; Flagstaff, Williams, Prescott, and Grand Canyon, Ariz. They were just starting at Trinidad on July 10 and at Wetmore contained adults on October 6. The flies probably emerge in November or early December. The galls were observed on *Q. gambelii*, *fendleri*, and *grisea.*

DISHOLCASPIS PRUNIFORMIS Kinsey

The galls of this species were collected on *Q. stellata* and *laceyi* at Austin, Boerne, and Kerrville, Tex. Galls at Austin contained pupae on October 30, November 13 and 21, 1917. Adults were cut out of the galls on December 10.

DISHOLCASPIS SILERI (Bassett)

The gall of this species, described from an unknown oak in southern Utah, is a monothalamous stem swelling resembling the eastern club gall on white oak. Galls which agree with the Bassett types have been collected by the writer on *Quercus gambelii*, *grisea*, *undulata*, and *reticulata* at the following localities: Wetmore, West Cliff, Trinidad, and Morley, Colo.; Wagon Mound, Rowe, Tijeras, Socorro, Magdalena, Nogal Canyon, and Fierro, N. Mex.; Prescott,

Flagstaff, Williams, Grand Canyon, and in Santa Catalina, Chiricahua, and Huachuca Mountains, Ariz. In all cases the collecting has been done at such a time that the maker has not been reared. The flies probably emerge just as the new wood begins to harden in midsummer.

DISHOLCASPIS SPONGIOSA (Karsch)

The galls of this species were collected on *Quercus stellata*, *margaretta*, and *chapmani* at the following localities: Thebes (E. Schwab) and Floyd's Island in Okefenokee Swamp (Dr. J. C. Bradley), Ga.; Green Cove Springs, Daytona, St. Petersburg, Clearwater, Ocala, Gainesville, Madison, Marianna, River Junction, and Tallahassee, Fla.; Montgomery and Troy, Ala.; Mineola, Palestine, Trinity, and Houston, Tex.; Texarkana, Hoxie, and Hot Springs, Ark.; Hugo and Tuskahoma, Okla.; Poplar Bluff and Ironton, Mo. In 1917 adults had emerged at Poplar Bluff by November 3, at Hoxie they contained pupae on October 10 and emerged November 16, at Palestine they contained pupae and adults on October 16. They emerged from Daytona galls on December 5.

DRYOCOSMUS COXII (Bassett)

Cynips coxii BASSETT, Canad. Ent., vol. 13, 1881, p. 112.
Andricus coxi BASSETT, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 320.
Andricus bassettianus DALLA TORRE and KIEFFER in Wytsman, Gen. Ins. Hym. Cynipidae, 1902, p. 61.
Plagiortrichus coxii (*Bassett*), KINSEY, Ind. Univ. Study 53, 1922, pp. 122–5.

The writer has collected the common fusiform stem swelling of this species on *Quercus emoryi* at Fierro, Kingston, and in the Burro Mountains, N. Mex.; in the Chiricahua, Huachuca, Mule, Patagonia, Tumacacori, Santa Rita and Santa Catalina Mountains, and at Bisbee, Nogales, Oracle, and Prescott, Ariz. The galls were seen on *Quercus hypoleuca* in the Santa Catalina, Patagonia, Huachuca, and Mule Mountains and at Fierro and Kingston. In April, June and July only old galls were found. E. Jacot collected a fresh gall in the Huachucas September 17, too immature to rear. The writer collected mature fresh galls on *emoryi* at Oracle on December 17 containing both pupae and adults which emerged January 4–24. Galls on *emoryi* from the Mule Mountains collected early in December gave adults December 31, January 13, 24, February 4 and 14. These flies run to *Dryocosmus* in the Tierreich key.

DRYOCOSMUS DECIDUUS (Beutenmueller)

Andricus decidua BEUTENMUELLER, Insect. Inscit. Menstr., vol. 1, 1913, p. 131.

These galls long known in literature under the name *decidua* before the adult was reared are the ones to which Dr. A. D. Hop-

kins referred under the name of "black oak wheat" in a note.[1] These specimens were from Wescott, Mo., and Texarkana, Ark. Doctor Hopkins collected galls at Kanawha Station, W. Va., September 25, 1923. The writer collected galls at Evanston and Highland Park, Ill.; Ironton and Poplar Bluff, Mo., and at Bluemont, Va. Galls collected at Evanston on October 8, 1916 contained pupae on September 22, 1917 and adults on November 16 which emerged March 23–April 22, 1918. After the galls drop they change shape somewhat as the thick nutritive layer is used up, becoming distinctly spindle-shaped and only a thin brittle shell is left in the swollen central region. As the flies reared agree with the type in having the mesoscutum smooth, parapsidal grooves complete, head sculptured, no malar groove, antennal segment 3 longer than 4 and claws simple, the species is here transferred to *Dryocosmus*.

DRYOCOSMUS FLORIDENSIS (Beutenmueller)

Dryophanta floridensis BEUTENMUELLER, Canad. Ent., vol. 49, 1917, p. 349.
Andricus peltatus WELLS and METCALF, Canad. Ent., vol. 53, 1921, pp. 212–3. figs. 2, 1–5.

The rearing of adults from the *peltatus* gall in the spring of 1923 enables the writer to supplement the original description of the female and describe the hitherto unknown male.

The female has the cheeks scarcely broadened behind the eyes, malar space without groove. Prothorax narrow in the middle. Parapsidal grooves percurrent. No median groove. Mesoscutum microscopically coriaceous but shining with a sparsely pubescent area about the anterior end of each parapsidal groove. Scutellum without distinct pits, the indistinct transverse groove bounded laterally by carinae which diverge back on to margin of disk. Disk finely rugose. Carinae on propodeum weak, enclosing a transversely elliptical area. Wing pubescent and ciliate. Abdomen of freshly killed specimen shows ratio of length to height to width as 30:32:22. Second tergite longer than 3–7, its hind margin making an angle of about 80° to longitudinal axis of abdomen. Ventral spine in side view conical, three times as long as broad. Length 2.7–3.2 mm. Average of 15, 3.06 mm.

Male.—Differs from female in having 15-segmented antennae, the third longest and slightly bent. The abdomen is shorter than the thorax and laterally compressed. Length 2.0–2.3 mm. Average of 10, 2.14 mm.

As the four type flies were almost wholly destroyed by pests before reaching the National Museum a female reared by the writer from the characteristic gall is chosen as a neotype. It is labeled "Alexan-

[1] Proc. Ent. Soc. Wash., vol. 5, 1903, pp. 151–2.

dria, Virginia, June, 1923, *Quercus palustris*," and from it the above notes were made.

William Beutenmueller has suggested in correspondence that this *peltatus* would prove to be the same as his *floridensis* and the rearing of adults of *peltatus* now enables me to compare them with cotypes of *floridensis* and they seem to me to be the same, even when compared in balsam mounts. *Peltatus* thus becomes a synonym of the older name *floridensis* and from the characters given it will be seen that the species goes in the genus *Dryocosmus* where it is evidently the vernal sexual form in an alternation.

Host.—*D. floridensis* was described from Spanish oak, *Q. rubra* (=*digitata*=*falcata*) and from Blue-jack oak, *Q. cinerea* (=*brevifolia*) from Florida; *peltatus* from *Q. marilandica*, and the writer here adds the following unrecorded hosts: *Q. nigra*, *Q. imbricaria*, *Q. phellos*, and *Q. palustris*. He has reared adults from *palustris*, *rubra*, and *imbricaria*.

Biology.—About Washington the galls may be found just starting in early May. They are then bright scarlet. As they develop the bracts become green and unless gall is parasitized turn brown about the time the adults emerge which is about the middle of June. For rearing the galls must be left on the tree until the pupa stage is reached and the living flies cut out of the dry galls later. May 27 was the earliest date at which a pupa was noted. By June 19, 1921, almost all the flies were out.

Habitat.—The species seems to belong to the Atlantic coast plain. The writer has seen galls at Chesapeake Beach, Md.; East Falls Church, Rosslyn, and Fredericksburg, Va.; Fairfax, S. C.; Marianna, River Junction, and Gainesville, Fla.; Troy and Dothan, Ala.; Palestine, Houston, Trinity, and Texarkana, Tex.; and at Tuskahoma, Okla. J. L. Zabriskie collected galls at Flatbush, N. Y.

DRYOCOSMUS IMBRICARIAE (Ashmead)

Andricus imbrecariae ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 122.
Holcaspis fasciata BASSETT, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 328.
Dryocosmus fasciatus (Bassett) WELD, Proc. U. S. Nat. Mus., vol. 61, 1922, art. 18, p. 7.

William Beutenmueller calls the attention of the writer to the fact that *fasciata* Bassett, described from *Q. ilicifolia*, is the same as *imbrecariae* Ashmead described from *Q. ilicifolia* and *imbricaria*. A comparison of the types confirms this conclusion. The original spelling *imbrecariae* is a typographical error and Ashmead had corrected it in his own copy of the paper to conform it with the name of the host oak. This "banded bullet" gall was reported by Miss Stebbins from two other host oaks, *Q. coccinea* and *velutina*. The writer here records as additional hosts, *Q. rubra*, *marilandica*,

cinerea, *catesbaei*, *texana*, and *laurifolia* and the following localities where the galls have been seen: Ithaca, N. Y.; Evanston, Wilmette, Winnetka, Glen Ellyn, and Kingston, Ill.; Kilbourn City and Delevan (D. Watt), Wis.; Webster Groves, Ironton, and Poplar Bluff, Mo.; Little Rock, Hot Springs, and Texarkana, Ark.; Hugo, Okla.; Palestine, Wharton, Victoria, and Boerne, Tex.; Troy and Dothan, Ala.; Cottondale, Marianna, River Junction, Madison, Live Oak, Gainesville, and Ocala, Fla.; Bluemont, Va.; Kanawha Station (A. D. Hopkins), W. Va., and Washington, D. C. Brodie collected galls on *Q. coccinea* at Toronto.

Galls collected at Evanston in fall of 1916 gave adults September 22, 1917, but a few galls still contained larvae indicating that the emergence is distributed over at least two seasons. From galls collected in fall of 1917 at Ironton flies issued before October 10, 1918, and some still contained larvae. Galls from Poplar Bluff in fall of 1917 gave flies October 10, 1918. From galls collected at Victoria, Tex., J. D. Mitchell reared flies November 20, 1906. The Ashmead types emerged September 6 and October 12 and Bassett's type flies also emerged in the fall.

DRYOCOSMUS PIPEROIDES (Bassett)

Andricus piperoides BASSETT, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 314.

Galls of this species were noted on the leaves of *Quercus maxima* at Evanston, Wilmette, Ravinia, Fort Sheridan, and New Lenox, Ill.; at Medina and Ithaca, N. Y.; and at Bluemont, Va. Some specimens sent from Cape Porpoise, Me., were determined by the writer as those of this species. Galls collected at Evanston in October, 1916, contained both pupae and larvae on September 17, 1917, and adults and larvae on November 15. Adults emerged April 22 to May 11, 1918. The emergence is evidently distributed over at least two seasons. From galls collected by William Beutenmueller at Fort Lee, N. J., in the fall of 1916 and sent to the writer for rearing flies emerged April 6, 11, and May 11, 1918. He writes that the galls were very common in the fall of 1916 and again in 1918, but none was noticed in 1917. Brodie collected galls at Toronto, but failed to rear the adults.

As the Bassett types have simple claws, a malar groove, mesoscutum bare and shining and head sculptured the species is here transferred to *Dryocosmus*.

DRYOCOSMUS RILEYI (Ashmead)

Andricus rileyi ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 121.

This species was described from St. Louis, Mo., from *Q. maxima* only. The writer has collected the galls on ten other oaks as fol-

lows: *Q. velutina*, *coccinea*, *marilandica*, *rubra*, *cinerea*, *nigra*, *catesbaei*, *imbricaria*, *texana*, and *laurifolia*, and records the following localities: Evanston, Winnetka, and Ravinia, Ill.; Ironton and Poplar Bluff, Mo.; Little Rock, Hot Springs, and Texarkana, Ark.; Palestine, Trinity, Wharton, Richmond, Boerne, and Kerrville, Tex.; Hugo and Tuskahoma, Okla.; Troy, Ala.; Cottondale, Marianna, and Ocala, Fla.; Washington, D. C.; Bluemont, Va.; Kanawha Station, W. Va. (A. D. Hopkins); Riverhead, N. Y. (C. R. Crosby); New York City (Beutenmueller).

Galls collected at Poplar Bluff in fall of 1915 gave adults Septemerb 25–October 21, 1916. From galls collected at Ironton in fall of 1918 by S. A. Rohwer two flies emerged March 15, 1920. From galls of 1911 on *coccinea* at Evanston adults emerged June 15, 24, 1912, and others in spring of 1913. As the mesoscutum of the type is smooth, the head sculptured, claws simple, no malar groove and third segment of antenna longer than fourth the species is here transferred to *Dryocosmus*.

LOXAULUS MAMMULA (Bassett)

Galls on *Quercus alba* collected at Apple Orchard Camp in Bedford County, Va., on June 27, 1920, had the nutritive layer used up and larvae full grown. Adults emerged some time in July.

LOXAULUS SPICATUS Bassett

Galls, agreeing with the Bassett type described from Arizona on "*Quercus virens*." have been collected by the writer from *Q. arizonica*, *oblongifolia*, and *toumeyi* in the Santa Catalina Mountains at Oracle and in Sabino Basin, in the Huachucas at mouth of Carr Canyon, in the Mule Mountains, in the Santa Ritas, and in Patagonia Mountains. From galls collected in December flies emerged December 31, January 1 and 24. They do not seem to be congeneric with the genotype of this genus but the species is left in *Loxaulus* for the present.

LOXAULUS TRIZONALIS, new species

SEXUAL GENERATION

Female.—Yellowish-brown, tip of antenna and mesonotum darker than head, abdomen darker behind; almost bare. Head coriaceous, from above semicircular in outline, broader than thorax, cheeks broadened behind eyes, occiput concave; from in front facial quadrangle one and three-tenths times as broad as high, malar space .44 eye with groove, antenna filiform, 14-segmented, lengths as (scape) 18 : 7 : 20 : 20 : 19 : 18 : 16 : 14 : 13 : 13 : 12 : 11 : 10 : 17. Pronotum narrowed to one-ninth in middle, sides coriaceous. Mesoscutum

wider than long, finely and uniformly rugose, parapsidal grooves complete, no median. Disk of scutellum more coarsely rugose, the transverse groove at base rugose, not bounded laterally. Carinae on propodeum almost straight and parallel with a trace of a median in inclosed area. Mesopleura coriaceous, shining. Hind tarsus shorter than tibia, its segments as 37:15:10:7:11 (with claw 14). Claws weak and simple. Wing pubescent, ciliate, with three prominent transverse bands of cloud and three clear areas. The narrowest cloud lies on the basal vein, the next begins at costal hinge and includes the basal half of the radial cell extending back to the anal vein, the largest occupies more than the apical fourth of the wing. The first abscissa of radius is arcuate, the second strongly curved and transparent, no areolet. Abdomen longer than head and thorax, length to height to width as 38:27:15, inserted obliquely, lengths of tergites along dorsal margin (knife-edged behind second) as 54:22:7:10:15:10, second bare at base, ventral valves slender, prominently protruding obliquely upward, the sheath over the valves of an unusual type, hypopygium long and prominent, the ventral spine slender, in side view two and one-half times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 2.8, ovipositor 5.3, wing 3.0. Length 1.65–3.45 mm. Average of 102 specimens 2.66 mm.

Male.—Differs in having 15-segmented antennae, lengths as 15:6:17:19:16:14.5:12:12:12:11:11:10:10:9:11. Abdomen shorter than thorax, triangular in side view, lengths of tergites as 6:42:14:3:0:2:12. Lengths, 1.9–2.6 mm. Average of 36 specimens, 2.23 mm.

Type.—Cat. No. 27197, U.S.N.M. Type, allotype, 12 male and 50 female paratypes. Paratypes at American Museum, Field, Stanford, Harvard, California Academy, and Philadelphia Academy.

Host.—Quercus chrysolepis.

Biology.—The flies were reared from a lot of galls (Hopkins U. S. No. 15613*b*) which were supposed at the time of collection, April 18, 1918, to have all been those of a species of *Disholcaspis.* When these flies emerged July 15–August 1, 1918, they were at first thought to be guest flies in the above gall whose maker does not emerge until late in the fall. But these flies have not at all the structure of guests and the gall from which they came is therefore not recognized or here described.

Habitat.—The type locality is Camp Baldy, Calif. Paratypes are from galls collected on the road from Holland, Oreg., to the Oregon Caves July 21, 1922, the flies emerging about August 1.

AGAMIC GENERATION

Female.—Similar in appearance to the female of the sexual generation except that freshly killed specimens from a breeding cage kept out-of-doors for three winters in the humid climate of Washington are darker in color than the seven-year-old museum material reared in the dry climate of California in July, only a short time after the galls were collected. The ovipositor ratio, however, is 3.3 and wing 3.5. Length 2.6–3.7 mm. Average of 97 specimens, 2.98 mm.

Host.—Quercus chrysolepis.

Gall.—A mass of easily separated contiguous single cells lying on one side of a nature acorn between the cotyledons and the acorn wall. There is no visible external sign of infection, but very large acorns in exposed situations on the tree seemed more liable to attack. The individual galls are irregular in shape, slightly flattened, blunt-pointed at the ends, 4–5 mm. long with exit hole 0.12 mm. in diameter.

Biology.—There is no experimental proof that this is the alternating generation, but the circumstantial evidence is strong. It would be strange to find two series of adults with such unusually marked wings emerging at different seasons from two strikingly different galls on this host oak, which has almost a unique cynipid fauna, unless they were so related. The longer ovipositor of the sexual female seems adapted for piercing acorns and the shorter one of the agamic female for laying eggs in small twigs. Because the author considers these as one species no specific name is given to the agamic form or type designated. The gall on the pin, the locality label, and the field-note number 1577 will serve to identify the agamic series before the author.

Habitat.—The affected acorns were collected at Idyllwild, Calif., on September 21, 1922, and the adults emerged at Washington, D. C., March 12–21, 1925. Others will emerge in spring of 1926.

PLAGIOTROCHUS SUBERI, new species

Female.—Black, legs yellow. Head coriaceous, radiating ridges about mouth, face pubescent; from above slightly broader than thorax, length to width as 21:40, cheeks not broadened behind eyes; from in front nearly circular, facial area slightly higher than broad, malar space 0.3 eye, antenna filiform, 14-segmented, lengths as (scape) 9:5:10:10:9:9:8:7:7:6:6:5:5:8, first two yellow, rest piceous. Sides of pronotum reticulate. Mesoscutum coriaceous, parapsidal grooves deep, smooth, percurrent, broader behind, no median, a few setigerous punctures along grooves. Scutellum with two large deep smooth pits at base, disk coriaceous. Carinae on propodeum widely diverging below and angled, enclosing an area in which there is a

distinct median carina. Mesopleura coriaceous with a smooth area at upper hind margin, sloping backward so that anterior legs are widely separated from second and third pairs. Hind tibia longer than tarsus, claws simple. Wings ample, hyaline, pubescent, ciliate, veins brown, first abscissa of radius arcuate, second nearly straight, radial cell five times as long as broad at base, areolet reaching one-fifth way and cubitus to the basal. Abdomen shorter than head and thorax, length to height to width as 17 : 15 : 9, lengths of tergites along dorsal curvature as 35 : 12 : 12 : 4 : 5 : 8, second bare at base. Ventral valves oblique, tip of ovipositor straight, ventral spine directed horizontally, slender, in side view three times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.5, ovipositor 1.8, wing 4.4. Length, 1.6–2.2 mm. Average of 200 measured specimens, 1.85 mm.

Types.—Cat. No. 27198, U.S.N.M. Type and 99 paratypes. Paratypes at American Museum, Field, Harvard, Stanford, Philadelphia Academy, California Academy, British Museum, Paris Museum of Natural History, and with Professor Tavares.

Host.—*Quercus suber*, the European cork oak introduced into California.

Gall (fig. 10).—Cells imbedded in the wood immediately under the normal bark on small slender twigs, sometimes occurring in such great numbers that the twig is uniformly hypertrophied to twice its normal diameter for several inches. The individual cells are elongated, 2.5 mm. long by 0.7 mm. in diameter, lying parallel to the axis of the twig, the exit hole through the bark 0.5 mm. in diameter.

Habitat.—The type is selected from material from a cork oak tree on the grounds of the Cottage City Nursery Co., north of San Jose, Calif. Paratype locality, Pasadena.

Biology.—When the San Jose tree was visited in company with Dr. H. E. Burke on May 16, 1918, it was almost in full bloom, the young leaves not yet half grown. Some of the cells were in the previous season's growth but most were in the two-year-old wood and a few in that still older. Almost every twig on the tree was more or less infested. When badly infested so as to be hypertrophied the twigs are killed and fully half of the small twigs in the upper part of the tree seemed to be dead. No other kind of gall was seen on the tree. A few adults had already emerged and were seen resting on the foliage but most were still in the pupa state. From twigs collected on that date and sent to the Eastern Field Station for rearing (Hopkins U. S. No. 15608*a*) adults emerged May 21 to June 5. Adults emerged at Evanston June 3–11. This tree had a trunk diameter of about 15 inches but nothing was learned as to its history.

On May 7, 1924, A. O. Larson collected more material of this species from a cork oak tree on North Orange Grove Avenue, Pasadena. Flies were emerging when this was received at Washington, May 17. When he revisited the tree on May 22 practically all had emerged and many of the twigs had died but still retained their leaves, badly disfiguring the tree. This tree is about 18 inches in diameter and undoubtedly planted about 25 years ago by the architect, not by the gardener who planted most of the ornamentals on the place.

As the gall resembles that of a European *Fioriella* on cork oak, galls and flies were sent to Prof. J. S. Tavares in Spain, who is familiar with the galls of the Iberian peninsula, thinking possibly this might be that European species which had been brought over years ago in the twigs of a young tree imported from Spain. But he did not know the gall, nor was the insect a *Fioriella*. No record is at hand of the introduction of the cork oak except by importation of acorns. There are said to be over 1,000 cork oak trees in the San Gabriel Valley descended from two trees on the Richardson farm at Alhambra grown from acorns sent to Don Benito Wilson by the Commissioner of Agriculture in 1860. It seems probable that this is a native Cynipid which has come over from the native oaks on to this introduced exotic ornamental tree, although all the galls of this type known to the writer on the native oaks are produced by entirely different genera.

Another tree infested with the galls of this species was discovered by Louis Kroeck in May, 1924, standing in a lumber yard—once a recreation park—in Santa Clara on land that once belonged to the mission. In April, 1924, Eric Walther found another infested tree in Golden Gate Park in San Francisco. He writes:

> This tree is about 35 years old and has evidently been suffering severe injury for years, the 2-year-old twigs being so heavily infested that they die and the first heavy storm causes them to break off, and so the tree looks as if it had been pruned annually.

PLAGIOTROCHUS SERRICORNIS (Kinsey)

Andricus serricornis KINSEY, Bull. Amer. Mus. Nat. Hist., vol. 46, 1922, p. 288, pl. 24, fig. 3.

The galls of this species have been collected by the writer on *Q. agrifolia* in the Santa Ana, Santa Monica, and San Gabriel Ranges, at Pasadena, Santa Anita (contained pupae April 20, adults emerging April 27), Newhall, Piru (flies emerging April 25, 1918), Fillmore, Ojai (galls about half grown on April 7, 1922), Carpinteria, Montecito, Santa Barbara, Gaviota, Santa Margarita, Paraiso

Springs, Los Gatos, Palo Alto, and St. Helena; on *Q. wislizenii* at Camp Baldy, Bagby, California Redwood Park, and Ukiah (adults out May 10–13, 1922).

TRIGONASPIS CUPELLA, new species

Agamic female.—Black. Head coriaceous; from above massive, twice as broad as long, cheeks broadened behind eyes, occiput concave; from in front elliptical in outline, width to height as 36:30, interocular space .58 transfacial and area 1.2 times as broad as high, malar space one-fourth eye with a slight groove, antenna 13-segmented, lengths as (scape) 12(width 5) : 8(5) : 14(3.5) : 13 : 9 : 9 : 8 : 8 : 7.5 : 7.5 : 7 : 6 : 10(4) last sometimes subdivided, flagellum gradually stouter to tip, faint median carina below median ocellus, broad low median ridge antennae to clypeus. Mesonotum nearly flat, as broad as long, without grooves or lines or transverse groove or suture between mesoscutum and scutellum, the disk with a few setigerous punctures. Carinae on propodeum diverging below around on to the sides of neck, spiracular areas pubescent. No trace of wings. Hind tarsus shorter than tibia, its segments as 16:7:4:3:8, claws with an obscure tooth at base. Abdomen longer than head and thorax, length to height to width as 78:61:20, lengths of tergites measured along dorsal curvature as 46:19:8:14:10:8, second bare at base, dorsal margin behind second knife-edged, ventral spine slender, six times as long as broad in side view. Using width of head as a base the length of mesonotum ratio is .57, antenna 2.3, ovipositor 4.3. Length, 1.3–2.0 mm. Average of 100 measured specimens, 1.58 mm.

Type.—Cat. No. 27199, U.S.N.M. Type and 39 paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus grisea, undulata, arizonica.

Gall (fig. 39).—A small black cup-shaped spangle scattered on upper and under surface of leaf in the fall and dropping with the leaf. From one to a dozen on a leaf. Galls measure up to 2.6 mm. in diameter and 2 mm. high, the exit hole in the shallow cup at apex, the mouth of the cup sometimes slightly constricted by the inrolled edges of the thick wall, the larval cell lying transversely at base of gall.

Habitat.—The type is selected from material on *Quercus grisea* from Magdalena, N. Mex., where the galls were very common in November 1921. Paratypes are from galls on *Q. undulata* at Tijeras in the Sandia Mountains. Flies emerged from both lots of galls from January 24 to February 6, 1922. Other paratypes are from *Q. arizonica* from the Mule mountains and from Oracle in the Santa Catalina Mountains, Ariz. Galls were observed on

these hosts at Nogal Canyon south of Socorro, Hillsboro, Kingston, and in Burro mountains, N. Mex., and at Prescott, Ariz. Similar galls were observed on *Q. oblongifolia* in the Huachuca and Patagonia Mountains.

TRIGONASPIS OBCONICA Weld

Galls of this species were observed on a dozen or more trees of *Quercus lobata*, a previously unrecorded host, at Cloverdale and Santa Rosa, Calif., on May 7, 1922, usually at the base of small trees. The galls were rosy when only slightly buried but white or yellowish if deeper. At this date the galls contained both pupae and adults, the flies emerging May 13, 17, 20.

BIORHIZA ELDORADENSIS (Beutenmueller)

The writer noted the occurrence of cells of this species in acorns of *Quercus agrifolia* at Ojai, Paraiso Springs, and Mount Diablo; on *Q. wislizenii* at Ukiah, in California Redwood Park, in the Santa Lucia Mountains, in the San Bernardino and Santa Ana (adults out September 23) Ranges, and at Idyllwild were adults emerged September 21 to October 1; on *Q. kelloggii* in the Sequoia National Park, in the California National Forest along the road from Upper Lake to Bartlett Springs, at Fort Jones, Scott Bar, and Milford, Calif., and at Siskiyou, Oreg.

BIORHIZA RUBINA Gillette

White or rosy translucent depressed spherical galls 2–3 mm. in diameter on under side of leaves of *Quercus alba* in fall, agreeing with the original description of the galls of this species, have been noted at Evanston, Lake Forest, and Clinton, Ill.; Ironton, Mo.; Medina, N. Y., and Bluemont, Va. Similar galls have been seen on the rock chestnut oak, *Q. montana*, at Bluemont and East Falls Church, Va. The writer has not reared the adult.

XANTHOTERAS FORTICORNIS (Walsh)

The oak-fig gall on *Quercus alba* has been observed at Cayuta Lake, Riverhead (Crosby), and Ithaca, N. Y.; Pitman (Bradley), N. J.; Ironton, Mo.; Tuskahoma, Okla.; Evanston, Glencoe, and Fort Sheridan, Ill.; Washington, D. C.; and Bluemont, Va. At Miller, Ind., it was just beginning to develop on June 30 and at Toronto Brodie says they begin to appear toward the end of June. At Riverhead they contained pupae on September 30. Galls collected at Ironton in October, 1917, containing adults were put out of doors in cage on ground on November 26 at Evanston, Ill. On

December 10 the thermometer registered —14° F. On December 18, when thawing again, dozens of flies were actively crawling about in the cage, having emerged either since November 26 or since December 10. More were found in cage February 19, 1918, and more March 11 and March 23. Brodie found the gall common at Toronto where adults issued November 4, 1885, and from November 12–21, 1886, over 300 were reared from another lot of galls. Some lived till January 29 but none survived winter. He examined over 800 specimens without finding a male. He says they oviposit in the roots. He received galls from 100 miles west of Winnipeg in Manitoba and says the producers could not be separated from Ontario specimens. He also had galls from Port Sidney, Muskoka, from which flies issued November 9.

XANTHOTERAS CALIFORNICA (Beutenmueller)

Philonix californica BEUTENMUELLER, Ent. News, vol. 22, 1911, p. 69.

The type material of this species was collected by Coquillett in Kern County, Calif., November 1, 1892, the flies emerging January 21 and February 2, 1893, the gall apparently on a leaf of *Q. dumosa.* The types have not the characteristic ventral spine of a *Philonix* and seem to go best in *Xanthoteras.* The writer has collected the galls on *Q. dumosa* at Bartlett Springs, Jolon, Paso Robles, and on Cajon Pass. From galls collected on Liebre Summit on the Ridge boulevard to Bakersfield on September 13 living flies were cut out on November 10. At Boulevard in March both old and empty galls were found and also new ones still thin as tissue paper and on the last season's leaves, as the new leaves had not yet appeared. The galls seem to be always on the upper side of the leaf. At Lebec a gall was collected on *Q. douglasii* and a living fly cut out November 10.

XANTHOTERAS TERES, new species

Female.—Head and thorax reddish-brown, the occiput, middle of face, antennae, mesopleura, and region of anterior lines infuscated, abdomen black. Head and thorax uniformly sparsely pubescent. Head granulate; from above broader than thorax, cheeks broadened behind eyes, occiput slightly concave; from in front facial quadrangle one and two-tenths times as broad as high, malar space .4 eye with groove, antennae 14-segmented, lengths as (scape) 12:6:16:13.5:11:10:9:8:7:6:6:5:5:7. Sides of pronotum and mesoscutum smooth with setigerous punctures, parapsidal grooves deep, smooth, percurrent, their separation behind only 3 times the width of a groove, no median. Disk smooth above, rugose behind, sides bounded

by diverging straight lines, transverse groove at base not distinctly divided into pits. Carinae on propodeum arcuate, enclosed area broader than high. Tarsal claws with a tooth. Wing reaching back to about the middle of second tergite, blunt, pubescent, venation normal as far out as costal hinge, a balsam mount of a favorable specimen shows the free part of subcosta, the first abscissa of radius and areolet obsolete, the second turning sharply upward toward wing margin, the cubitus represented by a linear cloud. Abdomen as long or longer than head and thorax, length to height to width as 26:21:17, lengths of tergites along dorsal curvature as 83:15:5:0:0:8, pubescent patches at base of second, its hind margin oblique, dorsal edge of next two knifelike. Ventral spine bristly, broad at base and tapering toward apex, mounted in balsam as broad as long. Using width of head as a base, the length of mesonotum ratio is .8, antenna 2.6, ovipositor 2.4, wing 1.1. Length 1.25–2.45 mm. Average of 14 specimens 1.97 mm.

Type.—Cat. No. 27200, U.S.N.M. Type and 5 paratypes. Paratypes in American Museum, Field, and Stanford.

Host.—Quercus garryana.

Gall (fig. 40).—A globular knob on a cylindrical stalk hanging from a vein on under side of leaf in autumn, dropping with the leaf, single or but few on a leaf, covered with a dense short woolly white pubescence which weathers away in old galls. They measure up to 5.5 mm. long by 2.5 mm. in diameter. Monothalamous. The pubescence consists of a dense layer of short brownish hairs like an inner fur at base of the long white hairs. Underneath is a thick brownish stony-hard layer and within a thin layer of light colored tissue in which is the larval cavity.

Habitat.—The type material was collected in Sequoia National Park on September 8, 1922, on the scrubby Kaweah oak above the Cedar Creek checking station on the Giant Forest road. Living flies were cut out of the galls on November 13. The galls were also collected at Fort Jones and Scott Bar, Calif., and at Siskiyou, McLeod, Wolf Creek, Oakland, Cottage Grove, and Salem, Ore. Fresh galls reach their full growth in late July.

XANTHOTERAS TUBIFACIENS, new species

Female.—Dark reddish-brown; face, sides of pronotum, and mesonotum covered with appressed white pubescence. Head coriaceous; from above as broad as thorax, cheeks not broadened behind eyes, occiput slightly concave: from in front facial quadrangle one and three-tenths times as broad as high, malar space .55 eye without groove, antenna 14-segmented, lengths as (scape) 11:6:12:10:9:8:7:7:6.5:6:6:6:5.5:7. Mesoscutum smooth with setigerous punctures,

parapsidal grooves smooth, deep, percurrent, no median. Pits of scutellum pear-shaped, smooth, widely separated, disk smooth in front, rugose behind. Carinae on propodem arcuate, enclosed area smooth, broader than high. Mesopleura smooth, bare. Tarsal claw with a strong tooth. Wing just reaching tip of abdomen, hyaline, pubescent, ciliate, venation normal, brown, second abscissa of radius nine and one-half times first, no areolet, cubitus indistinct. Abdomen longer than head and thorax, length to height to width as 95:79:56; lengths of tergites along dorsal margin as 58:20. 18:9:6:7, second with small pubescent areas at base, ventral spine slender, in side view about eight times as long as broad. Using width of head as a base, the length of mesonotum ratio is 1.0, antenna 2.7, ovipositor 5.4, wing 2.8. Length 1.5–2.35 mm. Average of 100 specimens 1.85 mm.

Type.—Cat No. 27201, U.S.N.M. Type and 39 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, California Academy, and Philadelphia Academy.

Host.—*Quercus garryana.*

Gall (fig. 41).—A convex mass of tubular galls standing side by side in a compact cluster on the under side of the leaf in the fall. The mass measures up to 25 mm. long by 15 mm. wide. The individual galls are easily detached, especially in preserved specimens, white or cream-colored, up to 9 mm. long, tapering gradually from the base to a diameter of about 3 mm. at the distal open end, the distal portion beset with tapering spines which are often rosy at the tip. The single larval cell lies midway of the length of the gall and measures about 2 mm. long by 1.2 mm. in diameter. The tissue of the dried galls is of crystalline hardness so that the insects are unable to chew their way out of preserved specimens.

Habitat.—The type material was collected September 8, 1922, in Sequoia National Park, Calif., just above the Cedar Creek checking station on the road to Giant Forest. At that time the galls contained full-grown larvae. Living flies were cut out of the galls on November 10. These galls were seen just starting to develop at McLeod, Oreg., on July 22. They were also seen at Yreka, Calif., and the Stanford collection has galls from Siskiyou, Oreg.

TRICHOTERAS COQUILLETTI Ashmead

The writer collected galls on *Quercus chrysolepis* at Camp Baldy, June 16, 1918, when they seemed too immature to rear but flies, agreeing with the types, emerged January 15, 1919. In September, 1922, galls were collected in the Santa Ana Mountains (a living fly cut out November 14) and at Idyllwild and adults were cut out on January 23.

XYSTOTERAS VOLUTELLAE Ashmead

This species, the genotype of *Xystoteras*, was described from a single specimen from Manhattan, Kans., from *Quercus macrocarpa*. The type galls are in the National Museum, but the type fly can not be found there, nor did Ashmead return it to Manhattan, as he is known to have done with certain species sent him from there.

The writer has collected galls which agree with the Ashmead types, and reared flies which agree with the original description except that balsam mounts show a tooth on the tarsal claws, which were described as simple. As the type seems to be lost it seems advisable to designate this series of reared flies as neotypes, and to add a few notes on the species to supplement the original description. The galls were collected in October, 1917, at Texarkana, Ark., on *Q. lyrata;* and, when a few were opened on November 21, some contained pupae and others living adults. The flies emerged (out-of-doors at Evanston, Ill.) on February 19, March 20, April 6, May 23, June 14 and 21, 1918. The same galls were seen at Poplar Bluff, Mo., on *Q. lyrata.*

The head from in front is as high as broad, malar space .28 eye with groove, antennal segments as (scape) 10:6:13:9:8.5:8:7:7:7:6.5:6:5.5:5:7. Hind tarsal segments as 22:9:6:5:10 (with claw 15). Lengths of tergites along dorsal curvature as 68:20:19:14:15:10. Ventral spine in side view four times as long as broad. Using width of head as a base the length of mesonotum ratio is .8, antenna 2.5, ovipositor 4.9. Range in length, 1.5–2.2 mm. Average of 100 specimens, 1.88 mm.

Cotypes of this series are in the National, American, and Field Museums, at Stanford, Harvard, and in Philadelphia Academy.

ZOPHEROTERAS COMPRESSA (Gillette)

Acraspis compressus GILLETTE, Bull. Ill. St. Lab. Nat. Hist., vol. 3, 1891, p. 197.

This species was described from two specimens cut from galls. The gall in the Illinois State laboratory is ellipsoidal, 2.7 mm. by 1.8 mm. by 1.8 mm., with a slightly wrinkled brown surface, the wall thin (.2 mm.) and made up of two about equal layers, the outer brown, the inner whitish. Their type fly has been lost. The remaining gall and fly in the Gillette collection have now been deposited in the National Museum. The following may be added to the published description: Malar groove present, hind tarsus shorter than tibia, claws simple. It is a *Zopheroteras.* Never having reared this species, which seems to be distinct from the following, the writer does not recognize the fresh galls in the field.

ZOPHEROTERAS SPHAERULA, new species

Agamic female.—Reddish-brown; antennae infuscated distally, abdomen posteriorly black. Head coriaceous; from above much broader than thorax, length in axial line to breadth as 18:55, occiput concave, cheeks ample but scarcely broadened behind eyes; from in front broader than high, facial area one and nineteen hundredths times as broad as high, malar space .3 eye with shallow groove, antenna 14-segmented, length as (scape) 15 (width 8) :7(6) :20(4.5) :15: 13:12:11:10:9:9:8:8:7:12(5). Sides of pronotum coriaceous and protruding. Mesonotum coriaceous. Mesoscutum .49 width of head with two distinct percurrent grooves well separated behind, with a hump behind middle when seen in profile. Scutellum reaching .6 way back to petiole with a large smooth deep laterally bounded pit at base in which is a slight septum, the disk narrow, elevated, and somewhat pointed behind when seen from above, rounded and knoblike in profile. Sides of metanotum almost horizontal. Carinae on propodeum curved outward, well separated above, enclosing the base of the reticulate neck. Mesopleura coriaceous. Wings wanting. Legs well developed. Hind tibia longer than tarsus, whose segments are as 33:11:8:6:13, claws large, simple. Abdomen large, attached to thorax near end of its short axis so that in side view it is elliptical in outline and obliquely placed, length to height to thickness as 39:29:15, lengths of tergites along dorsal margin as 16:7:5:5:4:1, dorsal edge knifelike behind second. Ventral valves oblique, tips exserted, tip of ovipositor strongly curved. Ventral valve slender, tapering, horizontal, in side view five times as long as broad. Using width of head as a base the length of mesonotum ratio is .7, antenna 3.0, ovipositor 7.1. Length, 2.0–3.5 mm. Average of 75 measured specimens, 2.44 mm.

Type.—Cat. No. 27202, U.S.N.M. Type and 29 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—*Quercus maxima*, red oak.

Gall.—Spherical or slightly ellipsoidal, not depressed, found in fall on both upper and lower surface of leaf attached to a vein, singly or 3–4 in a row, about 3 mm. in diameter, greenish or yellowish-green often tinged with red above, dropping to the ground before the leaves. Monothalamous, fleshy, apparently solid when fresh, the larval cavity scarcely visible.

Habitat.—Type locality, Evanston, Ill. The galls were also seen at Wilmette, Ravinia, and Moline, Ill.; Medina, N. Y.; and at Bluemont, Va.

Biology.—Galls collected on ground under two large forest trees on the bank of the Chicago River four miles west of Evanston on

October 8, 1916, contained pupae when examined September 17, 1917, and adults November 16, 1917, which emerged in numbers and were found alive in out-of-door breeding cage on March 13, 1918, others emerging before April 6.

KEY TO SPECIES OF ZOPHEROTERAS

1. Parapsidal grooves very indistinct especially posteriorly_____ 2
   Parapsidal grooves distinct and percurrent_____ 3
2. Carinae meeting above to form an arch below upper margin. Scutellum from above slightly pointed behind. Head slightly broadened behind eyes. Facial area one and fifty-six hundredths times as broad as high. Mesoscutum in profile showing hump behind_____ **compressa** (Gillette).
   Carinae widely separated at margin above. Scutellum rounded behind. Head not broadened behind eyes. Facial area one and thirty-seven hundredths times as broad as high. In profile the arch of mesoscutum is low and curvature uniform_____ **hubbardi** (Ashmead).
3. Mesoscutum, sides of pronotum, disk and mesopleura almost smooth. Mesoscutum in profile without hump behind. Body red___ **vaccinii** (Ashmead).
   Above parts distinctly coriaceous. Mesoscutum in profile with hump behind. Abdomen largely black_____ **sphaerula** Weld.

ACRASPIS ERINACEI (Beutenmueller)

The hedgehog galls of the agamic generation have been collected at Waterport, Syracuse (Crosby), and Ithaca, N. Y.; Elyria, Ohio; Porter, Ind.; Winnetka, Evanston, Glen Ellyn and Moline, Ill., Bluemont, Va., and Washington, D. C. At St. Louis, Mo., flies emerged December 4, 5, 23, 25, and January 3. Brodie found galls just starting at Toronto on June 28 and adults began to emerge October 20, 1886, and in 1892 they emerged October 24–28. In 1887 the galls were exceedingly abundant and he reared several thousands of the wingless flies without finding a male. In the Chicago area pupae were found inside the galls on September 8, 1906. On November 1, 1908, a cool day when scattered flakes of snow were flying, flies were emerging and observed ovipositing in the buds. Most of the leaves were still on the trees and they had only to crawl down the petioles to the terminal cluster of buds. Brodie found the galls everywhere common about Toronto on second growth trees, appearing about the last of June and falling with the leaves, the producers beginning to emerge November 20, in 1886, and from October 24–28, in 1892, not surviving the winter. He bred several thousand producers without finding a male.

The galls of the sexual generation of this species are thin and brittle-walled, whitish, blister-like swellings on the inner or concave face of some of the outer or lower bud-scales in the buds of the terminal cluster on *Quercus alba* in early spring. They are not usually visible until the buds have opened and the insects have escaped.

The easiest way to rear the flies is to locate a tree in the fall well-infested with the hedge hog gall and from this tree gather twigs in the spring just before the buds start, putting them in a bottle of water and setting the whole in a battery jar with a cloth over the top. The galls are common in the Chicago area, having been collected at Winnetka, Glencoe, and Willow Springs, Ill., and Miller, Ind. In 1909 adults issued May 17. In 1913 pupae were found in the galls on April 28 and adults issued May 1–20. At Washington an adult emerged May 6, 1924.

ACRASPIS HIRTA (Bassett)

Galls agreeing with the Bassett types on rock chestnut oak were collected on *Q. montana* at Storm King (M. D. Leonard), and Ithaca, N. Y., and at Bluemont, Va. They are found in September and October. No adults reared. Probably emerge in late fall.

ACRASPIS MACROCARPAE Bassett

Galls of this species on *Quercus macrocarpa* are here recorded from Evanston, Winnetka, Libertyville, Glen Ellyn, Fountaindale, and Moline, Ill. They contained pupae early in September, and living adults were cut from galls the last week of the month. Some emerged naturally November 14. From galls collected at Medina, N. Y., an adult emerged before December 5. Galls were seen also from Corinth, Iowa (C. Barracks); Cedar Point and Holton, Kans. Brodie collected galls at Toronto and producers emerged November 9–14, 1885, November 15–30, 1892, November 9, 1893, all apterous fertile females.

ACRASPIS PEZOMACHOIDES (Osten Sacken)

This species is here recorded from following localities: Medford and Pitman, N. J.; Syracuse (Crosby) (contained adults Sept. 30), Manorville (Crosby), Riverhead (Crosby), N. Y.; Falls Church, Va., Washington, D. C. (contained pupae September 19 and adults October 20), River Junction, Fla., Texarkana, Ark., Ironton and Poplar Bluff (cut out adults November 16), Kimmswich, Mo. Adults probably emerge in late November or early December.

ACRASPIS VILLOSA Gillette

Galls of this species were collected at Evanston and Winnetka, Ill., where living adults were cut out of the galls on November 1; and at Medina, N. Y., where pupae were found August 24 and September 4 and adults were cut out early in October. Professor Dudley collected galls on the shores of Seneca Lake, preserved in Cornell collection.

ACRASPIS GUADALOUPENSIS (Fullaway)

Callirhytis guadaloupensis FULLAWAY, Ann. Ent. Soc. Amer., vol. 4, 1911, p. 363, pl. 23, fig. 4.

Because of the rudimentary wings and the structure of the ventral spine this species is here transferred to *Acraspis*, although the wings are not reduced so much as in the eastern species of the genus, the mesonotum consequently being more robust, broader, and not so pointed behind. The galls are of a different type from those of the eastern species. The thin round disk-shaped galls are widely distributed in California on *Q. chrysolepis*. The writer has collected them at Idyllwild, in the San Bernardino, San Gabriel, and Santa Lucia Ranges, on Mount Diablo, in California Redwood Park, in Sequoia National Park, at Los Gatos, Calistoga, Ukiah, Shasta, Baird and Scott Bar, and at Canyonville, Oreg. The date of emergence is unknown but from galls collected in late September, living flies were cut out November 9.

What seem to be the same galls were collected on *Q. wilcoxii* in the Santa Catalina Mountains in Arizona.

ACRASPIS INSOLENS, new species

Agamic female.—Reddish-brown, more or less infuscated, abdomen black; face and thorax covered with appressed white pubescence. Head coriaceous, becoming rugose around mouth; from above broader than thorax, cheeks broadened behind eyes, occiput concave; from in front nearly circular in outline, facial quadrangle 1.1 times as broad as high, malar space nearly .4 eye without groove, antenna filiform, 14-segmented, lengths as (scape) 10:6:15:12:11:10:9:8:7:7:6:6:5:11. Mesoscutum broader than long, smooth with setigerous punctures, parapsidal grooves extending over one-half way, no median. Scutellum with smooth transverse groove at base bounded laterally, disk rugose behind, its sides bounded by diverging straight lines. Carinae on propodeum short, arcuate, not prominent, neck large, rugose. Mesopleura smooth. Hind tarsus as long as tibia, its segments as 26:12:7:5:18 (with claw 24), claw with a strong tooth. Wing reaching or slightly surpassing tip of abdomen, subhyaline, pubescent, ciliate, veins brown, first abscissa of radius straight, second strongly curved, free part of subcosta represented by a cloud, areolet and first abscissa of radius faint. Abdomen longer than head and thorax, truncate behind, length to height to width as 92:70:50, lengths of tergites along dorsal margin as 45:14:9:5:5:12, second pubescent at base, its hind margin at right angle to long axis of abdomen; ventral valves oblique, scarcely protruding; ventral spine hairy, short and broad, rounded at end. Using width of head as a base the length of mesono-

tum ratio is 1.1, antenna 2.7, ovipositor 2.8, wing 2.3. Length 2.0–2.6 mm. Average of 5 specimens 2.3 mm.

Type.—Cat. No. 27203, U.S.N.M. Type and one paratype. Paratypes at American Museum, Field, and Stanford.

Host.—Quercus chrysolepis.

Gall (fig. 42).—Somewhat wedge-shaped, hanging singly or in small numbers from the under surface of the leaf in the fall. The galls measure up to 10 mm. long by 5 mm. wide by 3 mm. thick, concave on the two broad sides, deeply grooved around the edge, nearly the color of the leaf, the flanges often reddish. The larval cavity is placed transversely at the apex of the gall and from it a long cavity runs up the center of the gall toward the pedicel.

Habitat.—The type material was collected September 21, 1922, near Idyllwild, Calif., on the slopes of Taquitz peak in the San Jacinto Mountains. Living adults were cut out of the galls on November 11.

ACRASPIS PATELLOIDES, new species

Agamic female.—Head and thorax yellowish-brown, antennae, tibiae and tarsi, median region of head from ocelli to clypeus, between anterior lines and disk of scutellum darker, abdomen reddish-brown to black. Head and thorax with dense appressed pubescence. Head granulate, broader than thorax, cheeks broadened behind eyes, occiput concave, malar space one-half eye without groove, antenna 14 segmented, lengths as (scape) 14:6:18:16:13:12:11:10:9:8:7:6:6:12. Mesoscutum broader than long, covered with setigerous punctures, parapsidal grooves incomplete. Disk of scutellum finely rugose, sloping and slightly pointed behind, an indistinct arcuate groove at base without pits. Carinae on propodeum arcuate but weak. Tarsal claws with a strong tooth. Wing reduced, reaching about to tip of abdomen, subhyaline, pubescent, ciliate, veins brown, second abscissa of radius faint, no areolet. Abdomen longer than head and thorax, length to height to width as 32:25:16, lengths of tergites along dorsal margin (knife-edged back of second) as 56:20:17:9:4:14, second pubescent on sides, exposed parts of tergites 3–6 aciculate ventrally, tuft of hair on sheath over ventral valves, ventral spine short, broad, rounded at end, bristly. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.6, ovipositor 2.6, wing 2.7. Lengths of four pinned specimens 2.7, 2.75, 2.0, and 2.95 mm.

Type.—Cat. No. 27204, U.S.N.M. Paratypes in Field and Stanford museums.

Host.—Quercus chrysolepis.

Gall (fig. 43).—Trotter described and figured the gall under the name *?Andricus patelloides*[2] in 1911. The galls are solitary or in groups of but two or three on under side of leaf. The underside is bowl-shaped, sessile, the top flat with a deep depression in center, measuring up to 13 mm. in diameter by 7 mm. high. When growing they are gray green like the leaf with a red line around the rim, maturing to a surface which in color and texture resembles that of an old and polished bone. The larval chamber, 2.9 mm. by 1.5 mm. lies transversely under the central depression and the exit hole is made through the thin roof into the bottom of this depression. Under the larval chamber a median cavity reaches to the point of attachment. The walls consist of dense brittle cellular tissue which, near the exterior, becomes more compact and forms a very hard thin peripheral layer.

Habitat.—The types are from galls collected September 7, 1922, in Sequoia National Park, Tulare County, Calif. The two living flies were cut out of the galls November 10. A paratype in balsam is from Idyllwild in the San Jacinto range and others are from Kern County galls collected October 23, 1892 (U. S. D. A. 5527), the adults emerging November 26, 1892. The writer collected the galls at Camp Baldy (Hopkins U. S. 15614*d*) and at Kyburz.

PHILONIX GIGAS Weld

In the paragraph on habitat in the original description of the species the following biological data were omitted. The galls were collected October 10, 1917, when some already contained pupae. A few adults were cut out of galls on November 16 and the rest of the galls put in an out-of-door breeding cage at Evanston, Ill. Here eight adults issued by December 1, and on December 18 three more living adults were found in the cage, the thermometer having registered −14° F. in the interval. Others issued early the next spring. The emergence must be distributed over at least two or three seasons, for normal larvae were found when the last of the galls were cut open December 2, 1919.

PHILONIX NIGRA (Gillette)

This species is here recorded from Evanston, Glencoe, Glen Ellyn, and Fountaindale, Ill.; Manistee, Mich.; Porter, Ind.; Kimmswick, Ironton, and Poplar Bluff, Mo.; Corinth (C. Barracks), Iowa; Nebraska City, Nebr.; Tuskahoma, Okla.; Marianna and River Junction, Fla.; Bluemont, Va.; Ithaca, Riverhead (C. R. Crosby), and New York City (Beutenmueller), N. Y. From galls collected at

[2] Boll. Laboro. Zool. Portici, vol. 5, p. 106, fig. 6, and Marcellia, vol. 10, 1911, p. 35, fig. 6.

Glencoe under a tree of *Q. alba* in October, 1916, two adults issued November 23 and five before December 11, 1916; about twenty-five emerged November 1–19, 1917 (one more was found alive in cage February 19, 1918); two December 2, 1919, the emergence being distributed over three seasons but beginning the first fall. An adult, determined as this species, was captured at Washington, D. C., December 9, 1923, by H. S. Barber. Brodie collected galls at Toronto October 10, 1886, and reared adults November 24, 1888. He collected others December 1, 1887, and reared adults November 24, 1888. From other galls gathered in December, 1896, the first emergence of the apterous females was on April 17, five months from collection of the galls and the last emergence was November 10–16, 1899.

A similar gall occurs on *Q. muehlenbergii* at Holton and Manhattan, Kans.

CYNIPS DIMORPHUS Beutenmueller

The type flies of this species are said to have emerged in the spring from galls collected the preceding year. In the fall of 1914 the writer collected galls at Highland Park, Ill., and reared adults on April 20 and 25, 1916. On October 1, 1916, some of the galls in the cage were opened and living flies found which would have emerged in the spring of 1917 but some of the largest galls still contained larvae which would not have transformed until the fall of 1917 and not have emerged as flies until at least as late as 1918. Thus the emergence does not seem to begin until the second spring and is distributed over at least three seasons.

The writer adds the following localities for the species, based on the observation of the galls on *Q. macrocarpa*, except when otherwise stated: Bluemont, Virginia, on *Q. alba;* Washington, D. C., on Q. *alba* and *Q. montana*; Forth Worth, Tex.; Ithaca, N. Y.; Cedar Point and Holton, Kans.; Nebraska City, Nebr.; Walnut Grove and Becker, Minn.; Wilmette, Winnetka, Glen Ellyn, Glencoe, and Moline, Ill. William Beutenmueller writes that the galls were very common at Highwood, N. J., in the fall of 1922.

CYNIPS HELDAE Fullaway

The original description gave no indication on what part of the plant the galls of this species are produced (the types are detached specimens). The writer has collected the galls at Chico, Lakeport, and Bartlett Springs, Calif. They are stem galls attached in clusters to the drooping branches of large trees. In August they were full grown but too immature for rearing, and in May only empty galls were seen. A. W. Gambs, of Cottonwood, in Shasta County, collected galls in January from which some flies had escaped, and others were still engaged in chewing their way out on January 23. About half of the galls still contained full-grown larvae.

CYNIPS MACULOSA, new species

Female.—Red, tips of antennae and abdomen darker; whole body except abdomen dorsally covered with silky yellowish-white pubescence. Head from above narrower than thorax, cheeks broadened behind eyes, occiput concave; from in front facial quadrangle nearly one and one-half times as broad as high, malar space half eye without groove, antenna filiform, 14-segmented, lengths as (scape) 15:8:25:21:18:17:13:12:10:9:9:8:8:12. Mesonotum smooth with setigerous punctures, parapsidal grooves deep, narrow, percurrent, no median. Sides of disk bounded by diverging straight lines, transverse groove at base. Usual carinae on propodeum wanting, neck rugose. Mesopleura smooth. Tarsal claws with a tooth. Wing subhyaline, with two clouds and many small spots, pubescent, ciliate, first abscissa of radius angulate, second curved upward distally and enlarged at apex but not reaching wing margin, areolet reaching one-seventh, cubitus five-sevenths way to basal, apical cell with about 13 small spots, mostly round, one or two elongated as though two spots had fused and in the base of the cell a cloud underneath an elongated spot; under the areolet in the discoidal cell a larger cloud and six or seven fainter spots. Abdomen longer than head and thorax, length to height to width as 44:31:31, lengths of tergites along dorsal curvature as 31:9:5:3:2:6, hind margin of second very oblique, ventral spine truncate, very broad with lateral lobes, bristly. Using width of head as a base, the length of mesonotum ratio is 1.4, antenna 2.2, ovipositor 2.8, wing 4.5. Length 3.1–4.3 mm. Average of 22 specimens, 3.79 mm.

Type.—Cat. No. 27205, U.S.N.M. Type and 9 paratypes. Paratypes in American Museum, Field, and Stanford.

Host.—Quercus dumosa.

Gall (figs. 11 and 44).—Globular, 5–7 mm. in diameter, attached by a short stout stalk to the midrib on the underside of the leaf in the fall. Greenish, mottled with white while growing, turning brown as they mature, a very thin papery epidermal layer becoming loosened and peeling off in fragments in old specimens. Inside is a darker stony-hard shell one-half millimeter in thickness, and within this a single larval cell supported by dense radiating fibers.

Habitat.—The type material was collected in Sequoia National Park, Calif., on September 9, 1922, between the western gate and the Cedar Creek checking station, on the Giant Forest Road. Some of the galls were still green and others turning brown. At that date they contained full-grown larvae, which pupated about October 1. The living flies were cut from the galls on November 10. The galls were also seen at Los Gatos and Lakeport and Ukiah. H. Morrison collected galls on Black Mountain, San Mateo County, in December.

1910, and reared an adult the next summer. Koebele collected galls in the Santa Cruz Mountains and others in Sonoma County.

CYNIPS MIRABILIS Kinsey

The writer collected galls of this species at Victoria, British Columbia; on San Juan Island, at Tillicum and Shelton, Wash.; at Albany, Corvallis, Eugene, Odell, Cottage Grove, Oakland, Canyonville, Wolf Creek, Kirby, Holland, McLeod, and Siskiyou, Oreg.; at Yreka, Fort Jones, Scott Bar, and Sequoia National Park, Calif. The National Museum has galls from Grants Pass and Goble (E. J. Perkins), Oreg., and O. J. Murie collected galls at Cottage City.

The young galls may be found in early July, becoming full-grown in August; they contain pupae in mid-September and the writer cut out living adults from the dry galls on November 10, January 13, and February 14. The forest-insect collection has flies from Ashland, Oreg., which emerged November 6 and April 1.

CYNIPS NIGRICENS Gillette

This species was described from Iowa and Michigan. The writer has found the galls at Bluemont, Va.; at Ironton, Mo.; and they were fairly common in the Chicago area, having been taken at Evanston, Wilmette, and Kenilworth, Ill. They start to develop about Chicago about August 1 and begin to drop late in September. They are much distorted in shape by mutual pressure in the cluster and inside the larval cavity is scarcely visible in the thick nutritive layer. During the winter on the ground the galls change shape, becoming plumper. From galls collected at Ironton in fall of 1917 adults issued April 11 and May 1, 1920.

The fly is described as having 13-segmented antennae. William Beutenmueller, who has seen the type, writes me that this is evidently a mistake. Flies he has reared and those I have reared all have the antennae 14-segmented. A fly from Algonquin, Ill., April 16, 1896 (Nason), determined by Gillette as "*Cynips nigricens*," has 14-segmented antennae.

CYNIPS PLUMBEA, new species

Female.—Red, slightly infuscated on anterior and lateral lines, ocelli and eyes black. Head coriaceous above, face pubescent; from above transverse, cheeks broadened behind the eyes; from in front facial quadrangle one and one-fourth times as broad as high, malar space .4 eye without groove, antenna filiform, 13-segmented, lengths as (scape) 16 (width 10) : 9(7) : 32(6) : 26 : 21 : 18 : 14 : 12 : 10 : 9(6.5) : 8 : 8 : 16, last with incomplete transverse groove on one side below middle. Sides of pronotum smooth, pubescent. Mesoscutum shin-

ing, granulate in front smoother behind with indistinct setigerous punctures, parasidal grooves deep, narrow, no median, hind margin arcuate. Scutellum disk finely rugose, its sides halfway back bounded by diverging carinae, no pits at base. Neck of propodeum rugose, the outwardly curved carinae discontinuous and branched. Mesopleura smooth, pubescent. Hind tarsus .7 as long as tibia, claws with a tooth. Wing hyaline, pubescent, ciliate, veins yellowish, first abscissa of radius angled and clouded, second nearly straight and enlarged near wing margin and parallel with it a linear cloud in upper third of third cubital cell and a shorter, less distinct one in lower third, both pointing toward the areolet. In some specimens these clouds are missing, especially in specimens cut from gall and killed at once. Areolet reaching one-sixth way to basal, cubitus reaching basal. Abdomen longer than head and thorax, length to height to width as 42:30:25, lengths of tergites along dorsal curvature as 36:8:5, hind margin very oblique, sides of all the tergites covered with white pubescence, ventral spine short, broad, rounded at end, bristly. Using width of head as a base, the length of mesonotum ratio is 1.3, antenna 2.4, ovipositor 1.9, wing 4.6. Length, 2.7–4.65 mm. Average of 102 measured specimens, 3.67 mm.

Type.—Cat. No. 27206, U.S.N.M. Type and 49 paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—*Quercus oblongifolia, arizonica*.

Gall (fig. 12).—Globular, 8–11 mm. in diameter, produced singly in the fall on the under side of leaf saddled on midrib. Lead color when fresh with a whitish bloom that easily rubs off and leaves a shining surface. Green or rosy on one side when growing, tan-colored when old. Monothalamous, the larval cavity surrounded by a wall about one-third the diameter of gall thick.

Habitat.—The type is selected from a series of 46 flies from galls on *Q. oblongifolia* collected November 27, 1917, by Hofer and Edmonston in Esperara Canyon (East) in the Santa Catalina Mountains, Ariz., the flies emerging December 14, January 8 and 25 (Hopkins U S. No. 13687*b*). One paratype is from Santa Catalina Mountains (Hopkins U. S. No. 13643*s*) reared November 22, 1915, M. Chrisman, collector; six are from galls on *Q. oblongifolia* collected by the writer in the Santa Rita Mountains December 7, 1921, when the galls contained pupae. The flies emerged January 12, 13, and February 3, 4. Forty-eight are from galls on *Q. arizonica* collected at Oracle on December 17, 1921 (Hopkins U. S. No 15639*b*), the flies emerging December 30, January 24, and February 6. One is from the Chiricahua Mountains, cut out of a gall on *Q. arizonica*

on November 24 and it lived in a pill-box until January 1. Galls have been observed at Nogales and in the Mule, Huachuca, Patagonia, and Tumacacori Mountains.

CYNIPS STROBILANA Osten Sacken

Galls of this species were collected on *Quercus bicolor* at River Grove and New Lenox, Ill.; at Ironton, Mo.; and at Great Falls, Va. They were found on *Q. macrocarpa* at Algonquin, Ill., at Fort Worth, Tex., and Miss Howe collected them at Ithaca, N. Y. William Beutenmueller writes that they were very abundant in the fall of 1922 at Highwood, N. J. Galls collected in Chicago area November 1, 1914, then contained a few adults as well as larvae. When opened April 24, 1916, larvae and living flies were found in about equal numbers. It is inferred that some flies emerge each spring for at least three seasons and Packard records finding an adult and a pupa in galls six years old. Galls were collected on *Q. lyrata* at Poplar Bluff, Mo., and at Hoxie and Texarkana, Ark., in November, 1917, when the fresh galls were almost solid and cut like cheese and the old galls contained pupae or adults which emerged and died in breeding cage before the middle of the next May.

CYNIPS SULCATA Ashmead

Described from "live oak" from Fort Grant, Ariz., the writer has collected galls and reared flies which agree with the Ashmead types from *Quercus arizonica*, *oblongifolia*, and *reticulata*. The Ashmead type galls seem to be on *Q. arizonica*. Galls on *arizonica* collected December 17 at Oracle contained pupae, adults emerging April 1–27. Galls from the Mule Mountains contained adults and pupae on January 13, flies emerging April 25. Adults emerged April 16–26 from galls collected in the Chiricahua Mountains. Galls from the Tumacacori Mountains gave flies March 8, April 6 and 26. In the Santa Rita Mountains on December 7 galls on *Q. oblongifolia* were greenish or if in the sun mottled with pink and just beginning to harden, containing full-grown larvae. Living flies were cut out on February 4. Galls were observed at Prescott, Nogales, Bisbee, and Patagonia.

CYNIPS WASHINGTONENSIS Gillette

The species was described from one specimen from Olympia, Wash., from *Q. garryana*. McCracken and Egbert reported it on *Q. lobata*, *dumosa*, and *durata*. The writer has collected galls on all these hosts and on *Q. douglasii* also as follows: on *Q. garryana* at Shelton and Tillicum, Wash., at Odell, Albany, Corvallis (adults nearly all emerged by August 24, 1916), Cottage Grove (some in pupa state July 18), Oakland, Wolf Creek, Holland, and Siskiyou.

Oreg., at Scott Bar and Yreka, Calif.; on *Q. lobata* at Chico (adult emerged after August 20), Ukiah, Cloverdale, Calistoga, St. Helena, Santa Rosa, Stockton (adult cut out August 29), Three Rivers, Palo Alto (contained adults August 16), Los Gatos, and Santa Margarita, Calif.; on *Q. dumosa* at Ukiah, Lakeport, St. Helena, Cloverdale, Palo Alto, Los Gatos, Paraiso Springs, Jolon, Paso Robles, Santa Margarita, Ojai, Liebre Summit on Ridge boulevard, in Santa Barbara National Forest, Bagby, Camp Baldy, San Bernadino Mountains (flies emerging September 30), San Jacinto Mountains (contained adults September 2), Santa Ana Range (contained adults September 18), and on Santa Catalina Island; on *Q. durata* at Bartlett Springs, Cloverdale, St. Helena, and Los Gatos; on *Q. douglasii* at Shasta, Red Bluff, Oroville, Placerville, Bagby, Three Rivers, Ukiah, Lakeport, Calistoga, St. Helena, Palo Alto, Los Gatos, Paraiso Springs, Bradley, and Lebec.

CYNIPS WELDI Beutenmueller

After the description of this species in 1918 more flies issued from the original lot of galls (collected in fall of 1914) on March 24 and April 10, 1919. The next spring the cage was not examined until May 1, when molded flies were found that probably emerged some weeks earlier. This makes it certain that the emergence of the species was distributed over at least five seasons and probably six. In addition to the published data on distribution, the writer has seen galls at Washington, D. C.; Bluemont, Va.; Marianna, Fla.; Texarkana, Ark.; Ironton and Poplar Bluff, Mo.; Porter, Ind.; and in Illinois at Evanston, Fort Sheridan, Lake Forest, Glen Ellyn, and Moline. Prof. C. R. Crosby collected galls at Syracuse and Riverhead, N. Y. Galls collected at Moline in fall of 1914 gave flies April 24, 1916. Galls collected at Glencoe in fall of 1916 gave flies March 23, 1918, and more March 24, 1919. Galls collected at Ironton in fall of 1917 gave flies March 20 to April 11, 1919, and more April 11, 1920. Brodie collected galls at Toronto in October, 1892, and found larvae alive in the galls May 24, 1894, but failed to rear the maker. Another lot collected at the same time he buried in the earth in a flower pot, and when dug up April 10, 1895, after 30 months, the galls were in good condition, with living larvae inside.

ANDRICUS ACICULATUS Beutenmueller

The galls of this species, described from *Q. stellata*, have been collected from two other host oaks, *Q. durandii* and *lyrata*, at Poplar Bluff, Mo.; Hoxie and Texarkana, Ark.; Trinity, Houston, Wharton, Cuero, Austin, Boerne, and College Station, Tex. From galls collected on *Q. lyrata* at Poplar Bluff in November, 1917, flies had

emerged by June 1, 1918. Galls at Hoxie on *lyrata* contained pupae November 16, and adults emerged at Evanston, Ill., May 16–20. On the twigs the old galls may be found from which the wool has weathered away, leaving a hard woody mass with exit holes in.

ANDRICUS ALBOBALANI, new species

Female.—Black, abdomen, legs and base of antenna red. Head from above transverse, broad as thorax, broadened behind eyes; from in front transversely elliptical, malar space one-half eye, with fan ridges, antennae 14-segmented, lengths as (scape) 12 (width 5) : 7(4) : 12(3.5) : 11 : 10 : 9 : 8 : 7.5 : 7 : 7 : 7 : 6.5(4.5) : 6 : 7(4). Thorax covered with appressed whitish pubescence. Mesoscutum broader than long, rugose, parapsidal grooves narrow, deep and smooth behind, becoming lost in sculpture anteriorly, no median. Disk rugose with two incompletely closed and separated pits at base. Carinae on propodeum bent outward enclosing a smooth area broader than high. Polished spot on mesopleura. Hind tarsus shorter than tibia, its segments as 24 : 11 : 7 : 5 : 12, claws weak, bidentate. Abdomen equal to head and thorax, length to height to width as 30 : 24 : 17, second and third tergites showing dorsally in proportion of 22 : 10, second with pubescent patches at base, ventral valves protruding, ventral spine tapering, in side view five times as long as broad, slightly hairy. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 1.9, wing 3.5, ovipositor 2.4.

Range in length, 2.2–2.9 mm. Average of five, 2.6 mm.

Type.—Cat. No. 27207, U.S.N.M. Type and one paratype. Paratypes at American Museum, Field, and Stanford.

Host.—*Quercus dumosa.*

Gall (fig. 45).—A single non-separable cell developed in the wall of acorn toward its base. Affected acorns are undersized, lopsided, firmly fastened in cup and remain on tree. Sometimes two in an acorn. Exit hole in wall of acorn near apex. Found in fall and winter.

Habitat.—Type locality, Boulevard, Calif., where affected acorns were collected on March 2, 1922, and seven living adults cut out. Transformation probably occurs in the fall and emergence in the spring. The finding of larvae in a few of the galls in March indicates that some individuals hold over and emerge the second spring. Similar galls were seen on the same oak at Descanso, Paraiso Springs, Los Gatos, St. Helena, and Lakeport.

ANDRICUS BICONICUS, new species

Female.—Black; mandibles, antennae, parts of legs brownish; abdomen reddish below. Head finely coriaceous with setigerous punctures, face pubescent; from above transverse, as broad as thorax,

occiput concave, cheeks broadened behind eyes; from in front widest above level of antennae, facial area one and six-tenths times as broad at high, malar space half eye with fine radiating ridges on either side of clypeus, antennae 13-segmented, length as (scape) 18 (width 7) : 9 (5) : 21 : 15 : 12 : 10 : 8 : 8 : 8 : 7 : 7 : 7 : 12 (6). Thorax sparsely pubescent, bare spot on mesopleurae and between parapsides behind. Pronotum with denser white pubescence, parallel ridges on sides. Mesoscutum coriaceous, the setigerous punctures not prominent, parapsidal grooves narrow, smooth, not quite reaching pronotum, separation behind four times width of groove, lateral lines smooth, anterior indistinct. Scutellum pubescent, rugose, the two widely separated pits at base opening out on to disk behind. Carinae on propodeum almost straight, bent in above and out below, enclosing area as high as broad. Tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, veins beyond second cross-vein pale, second abscissa of radius angled, areolet reaching one-fifth way to basal, cubitus indistinct. Abdomen shorter than head and thorax, length to height to width as 29 : 28 : 18, lengths of tergites along dorsal curvature as 80 : 20 : 7 : 1 : 0 : 12, second with hairy patches at base, ventral valves oblique but scarcely protruding, ventral spine tapering, in side view five times as long as broad, nearly horizontal. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 1.7, ovipositor 3.1, wing 3,6. Length, 2.5–3.75 mm. Average of 200 measured specimens, 3.19 mm.

Type.—Cat. No. 27208, U. S. N. M. Type and 89 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus stellata.

Gall (fig. 13).—Cluster at base of petiole of leaf in autumn. The clusters consist of as many as 20 individual galls which are closely packed, the basal half of each more or less distorted by mutual pressure. The individual galls are spindle-shaped, with pyramidal base and conical apex, up to 8 mm. long by 5 mm. in diameter, brownish, covered with stellate hairs, dropping when mature. Monothalamous, consisting almost entirely of nutritive material in which a larval cavity is scarcely evident when the galls drop. When the larvae finish feeding the wall left is only about 0.2 mm. thick. Diameter of exit hole 1.2 mm. This is the gall described by Wells.[3]

Habitat.—The types were reared from galls collected in fall and winter of 1919 at Denton, Tex., by R. L. Marquis (Hopkins U. S. No. 10767*c*[1]). A gall opened on November 7, 1920, contained a pupa which transformed November 12 and adults issued (at Washington) before March 12, 1921.

[3] Psyche, vol. 28, 1921, p. 44, fig. 27.

Galls have been collected at Poplar Bluff and Ironton, Mo.; Hoxie, Little Rock, Hot Springs, and Texarkana, Ark.; Palestine, Houston, Cuero, Boerne, College Station, and Arlington, Tex.; Tallahassee, Fla.; East Falls Church, Va.; Washington, D. C.

ANDRICUS CASTANOPSIDIS Beutenmueller

The writer collected galls on Mount Tamalpais, August 6, 1915. Some had already dropped to the ground. The growing galls are of a rosy-red color, fading to yellowish and tan as they mature. These galls were kept in a breeding cage out-of-doors and living flies were cut out of some August 13, 1917, while others still contained larvae. The collection at Stanford has flies which emerged July 7. Galls from Truckee were sent to the writer, collected by L. E. Hildebrand, September 10, 1915. A dead fly was found in the cage in August, 1918, and some of the galls still contained larvae. The emergence may be delayed evidently until as late as the fourth spring in some cases. Dr. E. C. Van Dyke sent galls from Inverness, in Marin County, and the National Museum has galls from Placer County. The writer saw the galls in California Redwood Park, on the Martis Peak trail at north end of Lake Tahoe, on Mount St. Helena in Lake County, and they were very common in the fall of 1922 on Taquitz Peak in the San Jacinto Mountains. Old galls were seen on top of the mountain above Siskiyou, Oreg. Prof. W. L. Jepson collected galls at Monterey and in Mendocino County.

ANDRICUS CHINQUAPIN (Fitch)

Figites chinquapin Fitch, 5th Rept. Nox. Ins. N. Y., 1859, p. 820.
Cynips fusiformis Osten Sacken, Proc. Ent. Soc. Phila., vol. 1, 1861, p. 61.
Cynips capsula Bassett, Canad. Ent., vol. 13, 1881, p. 101.

The two type galls of *chinquapin* in the National Museum from *Q. prinoides* are similar to those of *capsula* from *Q. bicolor* (another chestnut oak) and the two type flies of *capsula* sent by Bassett can not be separated from Fitch's type fly which, however, lacks the abdomen.

The holotype of *fusiformis* in the Museum of Comparative Zoology has not been compared directly with the above types but flies bred from the precisely similar gall on *Q. alba* can not be separated from them and the writer concludes that these three names all refer to one species making galls on different white oaks. This view has also been expressed by William Beutenmueller in letter.

The writer has taken the gall on *Q. montana*, rock chestnut oak, at Ithaca, N. Y.; Alexandria and Great Falls, Va.; Washington, D. C., where a fly ready to emerge was cut out of gall on May 31. On *Q. alba* at Evanston, New Lenox, (fly emerged June 7), and Fort

Sheridan, Ill.; Ironton, Mo.; Falls Church and Rosslyn, Va.; Plummer Island, Md.; Washington, D. C. Barlow collected them at Cadet, Mo., Miss Howe at Ithaca and Crosby at Farmingdale, N. Y. On *Q. bicolor* common at Wilmette and Evanston, Ill., where flies emerged June 15–23, 1909, and June 10–16, 1912. At Washington galls contained pupae May 6, 1914. These galls have also been seen on *Q. macrocarpa* at Winnetka, Ill. and on *Q. stellata* at Rosslyn, Va.

ANDRICUS CHRYSOBALANI, new species

Female.—Red, distal part of antenna and posterior portion of abdomen infuscated. Head broad as thorax, broadened behind eyes, malar space five-eighths eye with fan striae, antennae 13-segmented, lengths as (scape) 12(width 5) : 7(4) : 10 : 12 : 11 : 11 : 10 : 9 : 8 : 8 : 8 : 7.5 : 14(4.5). Sides of pronotum coriaceous, mesoscutum finely rugose, parapsidal grooves percurrent, faint median line extending to parallel lines. Disk coarsely rugose except for a finely rugose area behind the pits. Carinae on propodeum parallel. Hind tarsus shorter than tibia, its metatarsus as long as 2–4 united, claws with stout tooth. Fore wing hyaline, short pubescent, margin not ciliate, veins very pale, areolet faint and reaching one-sixth way to basal, cubitus scarcely visible. Abdomen as long as head and thorax, length to height to width as 23 : 23 : 14, second tergite occupying two-thirds, ventral valves oblique, ventral spine short, slightly hairy. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.5, wing 3.7, ovipositor 2.1. Range in length, 1.8–2.4 mm. Average of 33, 2.1 mm.

Male.—Similar to female but head darker, antennae 15-segmented, third slightly excavated and bent, the short pubescence on wing darker and veins more distinct, abdomen shorter than thorax, claws simple. Range in length, 1.6–2.0 mm. Average of 4, 1.8 mm.

Type.—Cat. No. 27209, U.S.N.M. Type female, allotype, one male and 11 female paratypes. Paratypes in American Museum, Field, Stanford, Harvard, Philadelphia Academy, and California Academy.

Host.—Quercus chrysolepis.

Gall (fig. 14).—Consists of a larval cell horizontally placed inside of and in very base of young acorns in midsummer. Affected acorns are those of the current season whose growth has been so retarded that they are undersized (10–18 mm.), often lopsided, with the cup more or less distorted. The cotyledons do not develop inside. The exit hole is in the top of the acorn and the cup is not involved.

Habitat.—The type locality is Kyburz, Eldorado County, Calif., where infected acorns of the current season were collected August 4, 1922. Some already contained fresh exit holes and one gall of those cut open contained a pupa. Flies emerged from the galls on August

19, 20, and 28, 1922, and when some of the galls were cut open the next July a few contained larvae indicating that the emergence of the species is probably distributed over two seasons..

Similarly affected acorns were observed on the middle fork of the Kaweah River in Sequoia National Park, on Mount St. Helena, on Mount Diablo, at Los Gatos, in California Redwood Park, in Palo Colorado Canyon in the Santa Lucia Mountains, at Camp Baldy in the San Gabriel Mountains, in Waterman Canyon in the San Bernardino Mountains, at Idyllwild in San Jacinto Mountains, and on trail to Santiago Peak in the Santa Ana Mountains.

ANDRICUS CORONUS Beutenmueller

Galls of this species were collected on the Capitol Grounds at Washington on *Q. phellos* by J. C. Crawford. They were beginning to drop on May 4. He reared adults April 23, 1910. The writer collected galls from a tree of *Q. palustris* on the Smithsonian grounds on May 16, 1920. Flies emerged April 10, 1921.

Galls have also been collected on *Q. phellos* at Clarendon and Cherrydale, Va.; Anniston, Livingston (J. W. A. Wright), and Montgomery, Ala.; and Rome (U. S. D. A. 5733), Ga.; and Tupelo (R. B. Deen), Miss.

ANDRICUS DECIDUATUS, new species

Female.—Head, anterior and parallel lines, pleurae, pits, propodeum, and abdomen black; antennae, sides of pronotum, rest of mesoscutum, disk of scutellum, and legs reddish-brown, much lighter in specimens cut out of gall in fall and killed at once than in those that emerged naturally in out-of-door breeding cage in spring. Head from above as broad as thorax, cheeks scarcely broadened behind eyes, vertex coriaceous; from in front transverse, interocular space .53 transfacial and area one and one-tenth times as broad as high, malar space .4 eye, antennae 13-segmented, lengths as (scape) 11:7:16:14:11:10:8:7.5:7:6:6:6:11, malar space faintly rugose, face and genae pubescent. Pronotum pubescent. Mesonotum with tawny appressed pubescence not dense enough to hide sculpture, lateral and parallel lines bare. Mesoscutum smooth and shining between the punctures, the parapsidal grooves deep, smooth, narrowing in front and not reaching as grooves much over half-way to pronotum. Scutellum rugose behind with slight tooth on each side, disk smoother with two distinctly separated smooth transverse pits at base. Carinae on propodeum slightly converging above, inclosing a smooth area broader than high, spiracular areas pubescent. Wing pubescent and ciliate, veins not heavy, second abscissa of radius not quite angled, radial cell three and one-half times as long

as broad, areolet reaching one-seventh and cubitus one-half way to basal. Hind tarsus shorter than tibia, its segments as 25:11:7:5:12, claws with a tooth. Abdomen as long as head and thorax, length to height to width as 25:21:15, lengths of tergites along dorsal margin as 57:18:8:4, all highly polished, second with patch of hair on each side at base, ventral spine slender, bare, in side view six times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.2, ovipositor 3.5, wing 4.0. Length, 2.0–3.3 mm. Average of 29 specimens, 2.58 mm.

Type.—Cat. No. 27210, U.S.N.M. Type and 10 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus bicolor.

Gall (fig. 15).—A small ellipsoidal deciduous bud gall on small twigs in the fall. Greenish-gray with longitudinal purple streaks, the surface pebbled under lens, 4.5 mm. long by 4 mm. in diameter, slightly pointed at apex with a heart-shaped base when detached in which is a round impressed scar. They are found in September, produced usually from one of the small lateral buds near the base of the current season's growth but sometimes occur as far back as on five-year-old wood, very rarely from a small bud in the terminal cluster on a weak branch. About the end of September they drop to the ground and the thin fleshy layer decays leaving a longitudinally ribbed hard thin-walled shell with a large larval cavity.

Habitat.—The type material was collected at Wilmette, Ill., September 10, 1917. Opened some of the galls September 3, 1918, and found living adults and left the rest to emerge naturally, which they did by April 10, 1919. These same galls were seen at Evanston, Winnetka, Ravinia, and Fort Sheridan.

ANDRICUS EXCAVATUS Ashmead

Galls agreeing with the types of this species on red oak, *Q. maxima* have been seen at New Lenox, Illinois on *Q. imbricaria;* at Ironton, Missouri on *Q. velutina;* at Mineola, Texas on *Q. marilandica;* and at Washington, D. C., on *Q. maxima.* No adults reared.

ANDRICUS EXIGUUS Bassett

This species has been reared from flower galls on *Q. stellata* at Washington, D. C., the flies emerging May 11, 1914, and in 1920 on May 9. The same species of adults was also reared from galls collected at Rosslyn, Va. In both cases the collection yielded flies of a *Neuroterus* and the writer has not definitely associated the *Andricus* with the gall from which it came.

ANDRICUS FEMORATUS Ashmead

Described from a female reared in May from gall on *Q. laurifolia* from "Florida," the type is labeled Jacksonville. The writer collected galls on *Q. laurifolia* and *phellos* at Jacksonville, Daytona, Gainesville, River Junction, and Tallahassee and secured a couple of adults which emerged some time after April 7.

ANDRICUS FIMBRIALIS, new species

Female.—Black, base of antenna, ventral spine and legs beyond coxae brown. Head granulate; from above transverse, broad as thorax, cheeks not broadened behind eyes, occiput slightly concave; from in front malar space .4 eye without groove, with radiating ridges from corners of clypeus, antenna 13-segmented, lengths as (scape) 11:7:13:13:12:11:10:10:9:9:8:8:17, last with trace of subdivision on one side. Sides of pronotum rugose. Mesoscutum coriaceous, dull except for shining smooth anterior and lateral lines, parapsidal grooves smooth, percurrent, median groove reaching forward half-way. Scutellum disk uniformly rugose with two smooth pits at base. Carinae on propodeum arcuate, neck rugose. Mesopleura striate. Tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, veins brown, first abscissa of radius arcuate, areolet reaching one-sixth way to basal, cubitus barely reaching basal. Abdomen as long as head and thorax, length to height to width as 68:50:40, lengths of tergites along dorsal curvature as 37:10:1, second but slightly pubescent on sides at base, ventral valves prominent, oblique, ventral spine normal, slender, in side view 3 times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.4, ovipositor 2.8, wing 4.0. Length, 1.55–2.0 mm. Average of 25 specimens, 1.86 mm.

Male.—Similar to female, but antenna 15-segmented and not lighter at base, first five segments as 11:7:15:15:13, third slightly bent, tapering from fourth to apex. Abdomen shorter than thorax, length to height to width as 40:30:21. Length, 1.1–1.65 mm. Average of 14 specimens, 1.46 mm.

Types.—Cat. No. 27211, U.S.N.M. Type female, allotype, 4 male and 10 female paratypes. Paratypes at Stanford, California Academy, American Museum, and Field Museum.

Host.—*Quercus dumosa, douglasii, lobata.*

Gall (fig. 16).—Globular, green, 2 mm. in diameter, produced at side of midrib of young leaves in early spring, stunting the development of the leaf, whose blade is much reduced, its margin prominently fimbriate.

Habitat.—The type is selected from galls collected on *Q. dumosa* May 3, 1922, along Pierce Mill Road, near Palo Alto, Calif., the

adults emerging May 10. Flies were emerging at Lakeport May 27. Three paratypes are from galls on *Q. douglasii;* two from galls collected at Paraiso Springs May 9, 1918, date of emergence not recorded, and one from Paso Robles, the fly emerging May 23, 1918. One paratype is from a gall on *Q. lobata* collected on May 20, 1922, the fly out and dead before May 27. The galls were seen on *Q. durata* also. In addition to the localities given above, the galls were also seen at Boulevard, in Santa Ana Mountains, on Santa Catalina Island, Camp Baldy, Bagby, Newhall, Santa Margarita, Jolon, Los Gatos, St. Helena, Calistoga, Ukiah, Bartlett Springs, Oroville, Red Bluff, Shasta, and Baird, Calif.

ANDRICUS FLOCCI (Walsh)

Galls were collected on *Quercus alba* at Evanston, Glencoe, Glen Ellyn, New Lenox, and Moline, Ill.; Porter, Ind.; Ironton and Poplar Bluff, Mo.; Texarkana, Ark.; Marianna, Fla.; and Bluemont, Va. Crosby collected them at Riverhead and Zabriskie at Nyack, N. Y. Brodie had galls sent to him from Manitoba from which flies emerged at Toronto May 20.

From galls collected at Ironton in October, 1917, adults emerged May 16–28, 1918. The forest-insect collection has flies that emerged April 22, 24, 30, and May 2 and 5, 1915, from galls collected at Lyme, Conn., by A. B. Champlain and flies that emerged April 14–16, 1915, from galls from Harrisburg, Pa. On April 15 William Middleton liberated some of the latter in a cage on a white oak tree and observed oviposition in one of the subapical buds. From the resulting gall he reared adults of both sexes on June 19—a suggestion for further experimentation.

ANDRICUS FOLIATUS (Ashmead)

This species was described from "Florida." Its galls occur on *Q. geminata* as well as on *virginiana.* Galls have been collected at Atlanta (E. A. Schwarz) and Savannah, Ga.; Jacksonville, Green Cove Springs, Crescent City, Daytona, Miami, Paradise Key (Hoppins U. S. No. 15580), Clearwater, St. Petersburg, Ocala, Gainesville, Live Oak, Marianna, Carrabelle, and Cottondale, Fla.; Mobile Bay (J. Hayes), Ala.; Wharton, Victoria, Cuero, Austin, Boerne, Kerrville, and Sabinal, Tex.

The galls may be found in various stages of growth in October, the galls and bracts being then green. Later in fall they turn brown. A gall collected at Paradise Key gave an adult February 26. Galls at Jacksonville contained adults ready to emerge on April 4, 1914.

ANDRICUS FOLIOSUS, new species

Female.—Dark red, legs and antennae yellowish, lines on mesoscutum and posterior part of abdomen often infuscated. Head as broad as thorax, coriaceous, face slightly pubescent, cheeks not broadened behind eyes, interocular space .6 transfacial and area one and four-tenths times as broad as high; malar space .54 eye, without groove; antennae 13-segmented; lengths as (scape) 12:6:15:12:11:10:9:9:8:8:7:7:14, not tapering toward tip. Pronotum with white pubescence. Mesoscutum coriaceous, with a few setigerous punctures, parapsidal grooves narrow, deep, smooth, shining, percurrent; anterior and parallel lines smooth; median groove developed posteriorly and continued forward as a percurrent line. Scutellum pubescent, coarsely rugose, with two large, well-separated, smooth, transverse pits at base. Carinae on propodeum slightly bent and inclosing a rugose area as broad as high, spiracular areas pubescent. Mesopleura aciculate below, polished above. Wing pubescent and ciliate; veins yellowish; second abscissa of radius arcuate; radial cell three times as long as broad, areolet reaching one-sixth and cubitus one-half way to basal, but both faint. Hind tarsus shorter than tibia; claws with tooth. Abdomen nearly as long as head and thorax; length to height to width as 85:65:51; lengths of tergites along dorsal curvature as 44:15, the rest hidden or showing but slightly; tip of ventral valves projecting dorsally; hypopygium long, pubescent; ventral spine slender, five times as long as broad in side view; second tergite with pubescent patch on each side at base, its posterior margin nearly at right angle to long axis of abdomen. Using width of head as a base, the length of mesonotum ratio is 1.2, antenna 2.3, wing 3.4, ovipositor 3.0. Length, 2.0–2.6 mm. Average of 104 pinned specimens, 2.3 mm.

Male.—Differs from female in having antennae 15-segmented, lengths as 9:6:15:11:10:9:8:8:8:7:6:6:6:6:7, last two-thirds tapering to tip, ratio 2.5. Abdomen shorter than head and thorax, lengths of tergites as 42:15:8:4:2:6, last four not always visible. Length 1.6–2.0 mm. Average of 22, 1.7 mm.

Types.—Cat. No. 27212, U.S.N.M. Type female, allotype, 9 male and 49 female paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—*Quercus bicolor* and *macrocarpa*.

Gall (fig. 17).—A fleshy green enlargement of the midrib or one of lateral veins usually on basal third of leaf blade, usually only one on a leaf. When seen from below there is a bend in midrib at this point and a small depressed spot. On upper side of leaf it shows a rosette of leaf-like rudiments hiding the gall; on the lower a smaller rosette on the concave side of the bend. The gall contains 1–6 larval cavities and the larva is much elongated like those in rose

galls. The young galls begin to show about the middle of May when the young leaves are not one-third grown.

Habitat.—The type locality is a tree of *Q. bicolor* four miles west of Evanston, Ill., out Emerson Street. Here the galls were observed year after year for several years. Galls collected June 6, 1909, gave flies in numbers June 29 and in early July. In 1912 adults emerged June 20–28. In 1913 they emerged on June 26. In 1916 the flies were mostly out by June 28 and galls beginning to dry up. In 1917 they contained pupae on June 24. The paratype locality is a tree of *Q. macrocarpa* in Winnetka, Ill. Miss Howe found galls at Ithaca and Geneva (see thesis) and the writer has seen them at Medina, N. Y., as well as at Evanston and Moline, Ill., on *Q. macrocarpa*.

ANDRICUS HOWERTONI Bassett

This species was described from a gall on an unknown oak in New Mexico. The writer has collected galls, which agree with a Bassett type gall, on *Q. undulata* and *grisea* at Las Vegas, Tijeras, Magdalena and Kingston, N. Mex. and at Williams, Ashfork, and Prescott, Ariz. Galls collected at Williams on April 11 gave adults by May 11 and some held over and emerged the next spring.

ANDRICUS INCERTUS Bassett

Andricus incertus BASSETT, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 317.
Andricus fimbriatus WELD, Proc. U. S. Nat. Mus., vol. 61, 1922, art. 19, p. 29–30.

The holotype of *incertus* was taken ovipositing in bud of *Q. bicolor* on April 22 at Waterbury, Conn., and is preserved in the Bassett collection in Philadelphia. In June 1921 S. A. Rohwer at my request took a paratype of *fimbriatus* to Philadelphia to compare with *incertus* and could see no difference. This species producing a gall in a fimbriate cup on acorn cup of *Q. bicolor* should henceforth be known as *incertus* Bassett. These galls have been noted at Washington, D. C. The alternating generation is unknown.

ANDRICUS LANIGER (Ashmead)

The live oak woolly midrib gall has been observed at Billy's Island in Okefenokee Swamp (Dr. J. G. Needham) and Savanah, Ga.; at Jacksonville, Green Cove Springs, Gainesville, Ocala and Clearwater, Fla.; at Sulphur (E. S. Tucker) and Audubon Park (E. R. Barber), La.; at Houston, Richmond, Wharton, Cuero, Sabinal, Austin, Boerne and Kerrville, Tex.

Galls were seen starting to develop at Sabinal as early as July 19. They become full grown before October, when certain trees contain incredible numbers of them, almost every leaf being infested. Such

a tree was seen at Richmond in the fall of 1917, and two years later the owner wrote:

> It is a pleasure to report that the infestation has disappeared wholly and that the tree is thriving and one of the prettiest in the row. No remedial measures at all were taken, so it appears that the insects were either affected climatically or were of a migratory nature. Following your visit, we had the severest winter of some years and then the driest summer for some time.

Pupae and adults were found in the galls December 8, and adults may be obtained by opening galls in winter. Galls from Billy's Island gave adults February 25 to March 9, but adults had not yet emerged on April 4 from galls collected on fallen leaves in the gutters on the streets of Jacksonville. Ashmead reared flies March 21, 1881. The alternating sexual generation is unknown.

ANDRICUS MURTFELDTAE Ashmead

This species was described from males only and no host oak was given for the galls. The description of the female is here given and some notes on the biology.

Female.—Head and thorax black; abdomen red, darker anterodorsally; legs and antennae honey-yellow. Face striate above mouth; malar space .5 eye, without groove; vertex coriaceous. Antennae 13-segmented, lengths as (scape) 15 (width 7) : 8(7) : 16(5) : 12 : 11 : 10 : 9 : 8 : 7 : 7 : 7 : 7 : 13(5). Mesoscutum coriaceous with a few setigerous punctures, shining. Parapsidal grooves deep, smooth, narrow, percurrent, wider behind, a faint trace of a median behind. Scutellum rugose, including the pits. Carinae on propodeum converging above. Wing pubescent and ciliate, radial cell 3.2 times as long as broad, open; areolet small, reaching about one-seventh way to basal, cubitus reaching basal; first abscissa of radius angled. Hind tarsus shorter than (.8) tibia, its metatarsus not equal to 2–5 (without claw). Claws with a tooth. Abdomen shorter than head and thorax, length to height to width as 30 : 26 : 22; relative lengths of tergites along dorsal curvature as 62 : 20 : 12 : 10 : 10 : 13, second bare at base. Ventral spine bare, about twice as long as broad in side view. Using width of head as a base the length of mesonotum ratio is 1.16, antenna 2.0, wing 3.5, ovipositor 2.47. Range in length, 1.7–3.2 mm. Average of 24 pinned specimens, 2.54 mm. Range in length of 17 males, 1.5–2.9 mm. Average of 17, 2.24 mm.

Host.—Quercus stellata.

Galls.—Produced in clusters about small twigs at base of the new growth, usually only 2–4 galls becoming well developed. It is an early spring gall, full grown but green and succulent soon after the tree is in blossom. Adults issue from the galls during the last of April in South Carolina and in late May and early June at Wash-

ington. The galls are then brownish and the interior has become quite hard. Easily detached.

Habitat.—The writer has collected fresh galls at Fairfax, S. C.: East Falls Church, Great Falls, and Rosslyn, Va.; and at Washington, and reared the adults in each case. Old galls were seen at Palestine, Cuero, and Arlington, Tex., still attached to the twigs in the fall. The National Museum has males from galls collected by A. D. Hopkins May 6, 1919, at Kanawah Station, W. Va. The type locality is Kirkwood, Mo.

ANDRICUS OSTEN SACKENII (Bassett)

Galls on *Q. coccinea* have been collected at Ithaca, East Hampton (C. R. Crosby), Farmingdale (C. R. Crosby), N. Y.; Evanston, Fort Sheridan, and La Grange, Ill.; and East Falls Church and Rosslyn, Va. In the Chicago area adults emerge July 8–15.

ANDRICUS PATTERSONAE Fullaway

The writer has collected the galls of this species on *Q. douglasii* at Kaweah, Palo Alto, Calistoga, Oroville, Red Bluff, and Shasta, Calif. Field museum has a gall from Chico, and Cornell has galls from Napa (J. C. Bradley). Only old and empty galls are found in May. Partly grown fresh ones were seen in August and full-grown ones in September. They should be gathered in late fall for rearing. Bethel collected galls determined by the writer as this species at Oakville, Wash., on *Q. garryana*.

ANDRICUS PATTONI (Bassett)

Galls of this species are common on *Quercus stellata* and were collected at Webster Groves, Ironton and Poplar Bluff, Mo.; Hoxie, Little Rock and Texarkana, Ark.; Cleveland (L. Haney), Okla.; Palestine, Trinity, Houston, College Station, and Arlington, Tex.; Troy, Ala.; Cottondale, Marianna, River Junction, and Madison, Fla.; Madisonville (W. L. Gordon), Ky.; and Washington, D. C. The galls occur in the fall dropping with the leaves. The larvae transform in late November, the adults remaining in the galls to emerge in the spring. Galls collected at Ironton October 5, 1917, gave adults (at Evanston) May 16, 28, June 2, 1918. Flies emerged (at Evanston) from Arlington galls May 16, 1918, and from Marianna galls May 1, 1920. Galls collected at Washington gave flies March 14, 1921, and in 1924 they emerged April 10–17. Galls sent to Washington from Kentucky gave adults March 14, 1921.

The similar galls on *Q. margaretta* give flies which do not seem to be different. The similar gall on *Q. chapmani* may also be due to this species. It is questionable whether this is specifically different from *Andricus floccі* (Walsh).

ANDRICUS PETIOLICOLA (Bassett)

Galls of this species were noticed at several localities and on several hosts. On the rock chestnut oak, *Q. montana*, at Watkins Glen, Ithaca (adults beginning to emerge July 10, 1913), and Storm King (Leonard), N. Y.; North East (contained pupae July 12, 1914), Pa.; Blue Hills, Mass.; Washington, D. C.; Alexandria and Bedford County, Va. Middleton reared adults at Falls Church, Va., on June 28. On *Q. macrocarpa* at Evanston, Willow Springs, and Clinton, Ill.; and Medina, N. Y., where they contained pupae June 30, 1914. Middleton reared flies at Falls Church, Va., June 27. On *Q. bicolor* at Evanston, Ill., where adults began to emerge June 23, 1906. On *Q. alba* at Willow Springs, Ill.; Poplar Bluff, Mo.; Alexandria and Bedford County, Va.; Forest Hills, Mass.; Ithaca, Farmingdale (Crosby), and East Hampton (Schradieck), N. Y. At Toronto Brodie found adults of both sexes emerging July 5–13, 1888. At East Falls Church, Va., flies emerged July 5, 1924. On *Q. stellata* at Hugo and Tuskahoma, Okla.; Arlington, Tex.; Troy and Dothan, Ala.; Marianna, River Junction, Carrabelle, Madison, Ocala, St. Petersburg, Daytona, and Green Cove Springs, Fla. At Rosslyn, Va., galls were full grown by June 1 and adults issued June 21–27, 1923. In 1924 adults emerged July 5 and were observed ovipositing in terminal buds.

ANDRICUS PISIFORMIS Beutenmueller

The writer has collected these vernal galls on *Q. alba* at Ravinia, Fort Sheridan and Willow Springs, Ill., and at Miller, Ind., in May; at Falls Church and Richmond, Va., and Jacksonville, Fla., in April. In the Chicago area a gall opened November 26 the same fall contained a pupa and at Falls Church adults were found as early as October 26, indicating that the larvae transform in the fall, the adults remaining inside the galls to emerge in the spring. They emerged from Jacksonville galls on February 27. Galls were noted on *Q. bicolor* at Evanston, Ill., just starting to develop on May 2, 1916. The twigs were cut off and put in a jar of water in laboratory where the galls became full grown and dropped off by May 28. On *Q. stellata* in Florida the galls were full grown on April 15. Many were badly deformed by guest flies, especially in basal half. They were also noted on this oak at Tuskahoma, Okla.; Rosslyn, Va.; and Washington, D. C.

This gall may be found in the spring just as the new leaves are unfolding. They develop from the weaker lateral buds usually on previous season's growth. When mature they drop to the ground showing a deep brown scar at point of attachment. The outer white

fleshy layer soon rots away leaving a hard, smooth, thin, brittle shell. For rearing they should be kept out-of-doors on the ground until spring.

ANDRICUS ROBUSTUS, new species

Female.—Black and red. In some the head and thorax are red, infuscated on anterior and parallel lines, others show all stages of coloration to black. Head punctate and pubescent except for bare area just above antennae; seen from above transverse, massive, as broad as thorax, cheeks strongly widened behind eyes; from in front broader than high, malar space .55 eye with striae on either side of depressed clypeus, facial area 1.4 times as broad as high, antenna 14-segmented, lengths as (scape) 19(width 7) : 8(6) : 22(5) : 18 : 14 : 12 : 9 : 8 : 8 : 7(7) : 7 : 7 : 7 : 14(6). Thorax with the aspect of a *Dischlocaspis* but parapsidal grooves are narrow, smooth and reach nearly to pronotum and scutellum has two distinctly separated small transverse pits at base. Mesoscutum coriaceous with uniformly distributed setigerous punctures, anterior and lateral lines shining, no median. Scutellum rugose behind, disk finely punctate. Carinae on propodeum nearly straight, slightly converging above. Bare polished spot on mesopleura. Tarsal claws with tooth. Wing hyaline, pubescent, ciliate, veins brown, second abscissa of radius angled, areolet reaching one-fifth way to basal, cubitus faint, reaching basal. Abdomen as long as head and thorax, length to height to width as 38 : 39 : 30, its longest dimension (45) oblique to main axis of body; lengths of tergites along dorsal curvature as 83 : 27 : 19 : 15 : 7 : 17, second with pubescent patches at base, seventh pubescent, ventral spine long and tapering, pubescent below, in side view eight times as long as broad and placed at angle of 45° to axis of body. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.4, ovipositor 4.4, wing 4.0. Length 3.0–4.1 mm. Average of 64 specimens 3.51 mm.

Type.—Cat. No. 27213, U.S.N.M. Type and 4 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, Philadelphia Academy, and with Beutenmueller.

Host.—Quercus stellata.

Gall (fig. 18).—A midrib cluster on under side of leaf in fall, the galls dropping to the ground when mature. The individual galls are somewhat globular, tapering to a pedicel at base and pointed with a slight scar at apex, greenish and mottled with white when fresh, turning brown during winter on ground. This is the gall described in connection with the fly of *Cynips vacciniformis* Beutenmueller which seems to have come from an accidentally included gall of a different sort in the breeding cage.

Habitat.—The type material was collected at Arlington, Texas, November 3, 1917, when the galls were still dropping to the ground. On December 1, 1919, living flies (that would probably have emerged in spring of 1920) were cut from the galls. Some of the same lot of fresh galls were sent to William Beutenmueller, who reared adults January 10, February 14, 15, 20, 21, 1919, and more in February, 1920. Paratype flies were cut out December 1, 1919, from galls collected at Texarkana, Ark., in October, 1917. The galls have been collected also at Webster Groves, Poplar Bluff, and Ironton, Mo.; Hoxie, Little Rock, and Hot Springs, Ark.; Palestine, Cuero, and Austin, Tex.; Cottondale, Fla.; Washington, D. C.; Falls Church, Va. Galls collected at Washington in late October, 1923, gave adults February 22, March 1, 14, 17, 1925, and these have been included among the paratypes.

ANDRICUS RUGATUS, new species

Female.—Black; mandibles red; antennae and parts of legs brownish. Head coriaceous with setigerous punctures; from above transverse, as broad as thorax, occiput concave, cheeks broadened behind eyes; from in front broadest above level of antennae, median ridge from antennae to clypeus, facial area one and three-tenths times as broad as high, malar space 0.4 eye, antennae 13-segmented, lengths as (scape) 13 (width 6) : 7 : 15(4) : 11 : 8 : 7 : 6 : 6 : 5 : 5 : 5 : 5 : 11(6). Thorax sparsely pubescent, bare spot on mesopleura and between parapsides posteriorly. Pronotum with parallel ridges on sides. Mesoscutum coriaceous, parapsidal grooves narrow, smooth, not quite reaching pronotum, separation behind five times the width of a groove. Scutellum rugose, smoother just back of the well separated pits which open on to disk behind. Carinae on propodeum nearly straight, converging above. Tarsal claws with tooth. Wing hyaline, pubescent, ciliate, veins brown, second abscissa of radius angled, areolet reaching one-fifth way to basal, cubitus indistinct. Abdomen shorter than head and thorax, length to height to width as 28 : 26 : 19, lengths of tergites along dorsal curvature as 75 : 23 : 14 : 1 : 3 : 7, second with sparsely pubescent patches at base, its hind margin making angle of 60° with long axis of abdomen, ventral spine tapering, in side view five times as long as broad, directed almost straight backward. Using width of head as a base the length of mesonotum ratio is 1.2, antennae 1.8, ovipositor 2.5, wing 3.6. Length, 2.8–3.1 mm. Average of 4 specimens, 3.0 mm.

Type.—Cat. No. 27214, U.S.N.M. Type and one paratype. Paratype in Field Museum.

Host.—*Quercus lyrata.*

Gall (fig. 19).—A midrib cluster of a few galls on under side of leaf in fall, dropping to ground when mature. The individual galls are nearly globular, up to 6 mm. in diameter, dark red in color, covered with short blunt tubercles, have a scar at apex and are drawn out at base into a short pedicel. Monothalamous.

Habitat.—The type material was collected at Hoxie, Ark., October 10, 1917. Two adults issued April 11, 1920, and both larvae and pupae were found inside of galls opened October 10, 1920, indicating that the emergence is distributed over at least three seasons. Galls were seen also at Texarkana and at Poplar Bluff, Mo.

ANDRICUS SALTATUS Ashmead

Described from *Q. cinerea* from "Florida," the writer collected galls like the types at Jacksonville and Ocala in April on *Q. rubra*, the Spanish oak, but failed to rear adults.

ANDRICUS SINGULARIS (Bassett)

These galls on red oak, *Q. maxima*, were collected at Evanston, Glen Ellyn, and Willow Springs, Ill.; Delevan (D. Watt), Wis.; North East, Pa.; Medina and Ithaca, N. Y.; Bluemont, Alexandria, and Bedford County, Va. At Medina adults issued July 3, 1914. Brodie found the galls at Toronto and says the flies are usually all out by the middle of July but in 1891 they emerged July 14–27, males appearing first. Middleton reared flies July 6 from galls collected at Plummer Island, Md.

ANDRICUS SPECTABILIS Kinsey

This species was described from *Q. chrysolepis*. The writer has collected galls on *Q. wilcoxii* in the Santa Catalina and Chiricahua Mountains, Ariz., where on November 28, 1921, the galls on the current year's wood were but partly grown and those on 1920 wood still without exit holes but containing living adults. The writer collected galls on *Q. chrysolepis* in Waterman Canyon in the San Bernardino Mountains on March 18, 1922, and cut out living adults apparently nearly ready to emerge. Other nearly full-grown galls contained much nutritive material in the cells and small larvae. Galls on *chrysolepis* were collected at Idyllwild, in Santa Ana Range, on Mount Lowe (J. Martin), in Sequoia National Park, in Fresno County on Horse Corral trail, in Yosemite National Park (J. C. Bradley), Placerville, Kyburz, Pulga, in Santa Lucia Range, Los Gatos, on Mount Diablo, St. Helena, Ukiah, in Lake County above Upper Lake, Baird, Scott Bar, California; and in Oregon at Holland and Canyonville. Adults of the species were captured on

the foliage of *chrysolepis* in California Redwood Park on April 22, 1922. Partly grown galls may be found from early May on through the summer and it seems probable that the insects do not emerge from them until the second spring.

ANDRICUS STELLARIS, new species

Female.—Red, with tip of antenna, vertex, scutellum, propodeum, and tip of abdomen infuscated, face slightly pubescent. Head finely coriaceous; from above as broad as thorax, cheeks scarcely broadened behind eyes, occiput not concave; from in front malar space .35 eye without groove, antenna 14-segmented, filiform, lengths as (scape) 9:6:11:8:7:7:6:6:6:5.5:5:5:5:6. Mesonotum finely coriaceous with a few scattered setigerous punctures, shining, parapsidal grooves deep, narrow, smooth, percurrent, no median. Scutellum with two large smooth pits at base, disk rugose, its sides bounded by diverging lines. Carinae on propodeum diverging below on to sides of the rugose neck. Hind tarsus shorter than tibia, tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, veins very pale, cubitus and areolet scarcely visible. Abdomen length to height to width as 62:55:33, lengths of tergites along dorsal margin as 50:15, ventral valves oblique, ventral spine slender, 7 times as long as broad in side view. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.8, ovipositor 4.3, wing 4.6. Length 1.6–1.85 mm. Average of 7 specimens, 1.74 mm.

Type.—Cat. No. 27215, U.S.N.M. Type and 2 paratypes. Paratypes in American Museum, Field and Stanford.

Host.—Quercus garryana.

Gall (fig. 46).—A hemispherical gall, 3–4 mm in diameter and 2 mm. high, covered with short, blunt crystalline protuberances with a circle of 12–15 longer, broad and flat projections at the base resembling an open specimen of a many-rayed species of the fungus *Geaster*, attached singly or scattered in small numbers on the under side of the leaf in the fall. The galls are yellowish-white, often tinged with red. The larval cell lies transversely in the very base of the gall and above it is a cavity above which the crystalline wall of the upper part of the gall is very thick.

Habitat.—The type material was collected September 8, 1922, in Sequoia National Park, Calif., just above the Cedar Creek checking station on the Giant Forest road. The flies were cut out of the galls the next spring, having died inside, unable to chew their way out of the hard preserved galls. Koebele collected galls in Sonoma County.

ANDRICUS STROPUS Ashmead

The types of this species were reared in March. The writer has collected galls like the types at Daytona, St. Petersburg, Clearwater, Marianna, and Ocala, Fla., on *Q. chapmani* and at Palestine, Tex., on *Q. stellata*, but has never reared adults.

ANDRICUS TOUMEYI, new species

Female.—Red, slightly infuscated on anterior and lateral lines, on sternum and ventral part of abdomen in these recently transformed specimens cut from galls, no doubt still darker in those emerging normally. Head coriaceous, with radiating striae about mouth, face, and occiput pubescent; from above transverse, as broad as thorax, cheeks broadened behind eyes; from in front facial area higher than broad, malar space three-eighths eye, antenna 13-segmented, lengths as (scape) 14:8:14:13:12:11:10:10:9:9:9:8:15. Sides of pronotum with parallel ridges, pubescent. Mesoscutum coriaceous with scattered setigerous punctures, the hairs short and white, not hiding sculpture, parapsidal grooves deep, smooth, percurrent, wider behind, no median. Scutellum rugose with two deep smooth pear-shaped pits at base. Carinae on propodeum straight and parallel, enclosed area broader than high. Mesopleura aciculate except for smooth hind margin. Hind tibia longer than tarsus, claws with a weak tooth. Wing hyaline, short-pubescent, ciliate, veins yellowish, first abscissa of radius angled, areolet incomplete, cubitus indistinct. Abdomen longer than head and thorax, length to height to width as 120:98:80, lengths of tergites along dorsal curvature as 104:16:5:5:4:12, second with small pubescent areas at base, ventral valves hidden, ventral spine slender, in side view 7 times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.0, ovipositor 2.0, wing 3.8. Length 2.7–3.3 mm. Average of eight, 3.0 mm.

Named for Professor Toumey, to whom also the host oak is dedicated. Closely related to *Andricus howertoni* Bassett, from which it may be separated by the aciculate mesopleura and the more scattered pubescence on the mesoscutum.

Type.—Cat. No. 27216, U.S.N.M. Type and 3 paratypes. Paratypes in American Museum, Field, and Stanford.

Host.—Quercus toumeyi.

Gall (fig. 20).—A sessile, egg-shaped and somewhat one-sided stem swelling, representing a much shortened lateral branch which seldom continues beyond the gall, densely covered with small leaves. It measures up to 15 mm. long by 10 mm. in diameter, is covered with bark of normal thickness, its single rather small cell is placed

somewhat radially without any false chamber and the exit hole is in one side.

Habitat.—Type material collected at Patagonia, Arizona, on December 12, 1921, when the galls contained pupae. The adults were cut out of the galls on January 1. One paratype was cut from a gall collected in the Chiricahua Mountains. Similar galls have been seen on *Q. undulata* on Abo Pass in the Sandia Mountains, near Socorro, in Nogal Canyon, and in Burro Mountains in New Mexico.

ANDRICUS TUBALIS, new species

Female.—Dark reddish-brown, mesonotum and posterior third of second tergite nearly black, antenna yellowish. Head granulate, coriaceous above antennae; from above transverse, broad as thorax, cheeks narrow, but slightly broadened behind eyes, occiput not concave; from in front malar space .4 eye without groove but fine ridges from corners of clypeus, antenna filiform, 13-segmented, lengths as (scape) 14:6:12:12:11:10:10:9:9:8.5:8:7:12. Sides of pronotum rugose, pubescent. Mesoscutum dull, coriaceous with scattered setigerous punctures, parapsidal grooves smooth, wider behind, obsolete anteriorly, no median. Scutellum with two pits at base, disk rugose, sloping laterally from a median coriaceous ridge. Carinae on propodeum short, stout, slightly arcuate. Mesopleura striate between shining coriaceous areas above and below. Hind coxa and femur stout. Claws with tooth. Wing hyaline, pubescent, ciliate, veins yellowish-brown, cubitus and anal scarcely visible, first abscissa of radius angulate, areolet large but faint. Abdomen as long as thorax, length to height to width as 36:35:22, lengths of tergites as 34:2, rest telescoped, valves oblique, ventral spine slender. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 1.9, ovipositor 2.0, wing 3.1. Length, 2.8 mm.

Type.—Cat. No. 27217, U.S.N.M. Paratype in balsam with author.

Host.—*Quercus arizonica.*

Gall (fig. 21).—Arising from a weak bud on small twigs, usually on wood of previous year, easily detachable. Trumpet-shaped, the outside fluted, tapering to a sessile or clasping base, the flaring end forming a shallow cup in the bottom of which is the exit hole, 5–8 mm. long, cup up to 7 mm. in diameter, yellowish-white in color. The single larval cell lies longitudinally in the cylindrical stem of the gall, no false cavity present.

Habitat.—The type material was collected June 22, 1918, at Oracle, Ariz. The two adults emerged and died before August 23. Empty galls were seen at the same locality in December, 1921. Precisely similar galls were observed on *Q. oblongifolia* at Nogales.

ANDRICUS TUBULARIUS, new species

Female.—Head and thorax reddish-brown, infuscated about metanotum, abdomen red. Some have vertex and whole thorax more or less infuscated. Face, sides of thorax and scutellum with short white pubescence. Head granulate, broad as thorax, cheeks broadened behind eyes, occiput concave, malar space .35, eye without groove, fine radiating ridges at corners of clypeus, antenna filiform, darker distally, 15-segmented, lengths as (scape) 12:8:19:19:15:14:11:11:9:9:9:8:8:8:11. Mesoscutum shining, microscopically coriaceous with scattered setigerous punctures, parapsidal grooves narrow, smooth, complete, no median groove but a median pebbled streak extends halfway back to scutellum. Scutellum rugose with two smooth transverse pits at base. Carinae on propodeum nearly straight, slightly converging above, neck rugose. Mesopleura with a smooth bare area. Tarsal claws with a tooth. Wing hyaline, pubescent, ciliate, veins brown, radius heavy, first abscissa angulate and slightly clouded, areolet reaching one-fifth, cubitus three-fourths way to basal. Abdomen as long as thorax, length to height to width as 20:18:13, lengths of tergites along dorsal margin as 52:16, rest hidden, second with pubescent areas on sides, ventral spine short, in side view three times as long as broad, pubescent, from below tapering from base to apex. Using width of head as a base, the length of mesonotum ratio is 1.3, antenna 2.5, ovipositor 2.8, wing 4.0. Length, 1.65–2.5 mm. Average of 42 specimens, 2.18 mm.

Type.—Cat. No. 27218, U.S.N.M. Type and 15 paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus undulata.

Gall (fig. 22).—Smooth, tan-colored, blunt, cylindrical cells bursting out through the bark singly or in vertical rows of 2–6, only the upper third or less protruding, not deciduous. Single cells measure 3.2 mm. long by 1.7 mm. in diameter with wall .1–.2 mm. thick. Occur in early summer on small twigs of previous season's growth. Exit hole at apex and old galls show as a row of holes.

Habitat.—The type material was collected April 6, 1918, near mouth of Tijeras canyon in the Sandia Mountains, N. Mex. (Hopkins U. S. No. 15626*e*). Adults emerged April 12. Galls were seen at same locality in November, 1921, the cells then just bursting through the bark. Galls were collected in the Magdalena Mountains also.

ANDRICUS UTRICULUS (Bassett)

These galls on *Q. alba* leaves have been seen at Winnetka, Ravinia, Fort Sheridan, New Lenox, Utica (Starved Rock), and Moline, Ill.; at Ithaca, N. Y.; at Rosslyn and Alexandria, Va.; at Plummer

Island, Md.; and Washington, D. C. Flies emerged from the Ithaca galls on June 15, New Lenox, June 16. Similar galls on *Q. stellata*, giving similar flies, have been seen in Virginia and Texas. William Beutenmueller collected them at New York City, the flies emerging June 5, 1915.

ANDRICUS WILTZAE Fullaway

This species was described from Palo Alto, Calif., from *Q. lobata*. The writer has collected galls on this oak at Palo Alto, Paraiso Springs, Paso Robles, Kaweah, Visalia, Stockton, Oroville, Chico, Red Bluff, Upper Lake, Lakeport, Ukiah, and Santa Rosa. Dr. J. C. Bradley collected galls at Sacramento and Davis, March 9, 1918, and reared adults, some of which were still alive in the box on May 10. The young galls may be found developing in early September. The writer reared flies which agree with the Stanford type from galls on *Q. dumosa*, flies emerging April 5 from galls collected at Descanso on March 6 and from galls collected in the Santa Ana range on March 16. On March 18 a living fly was cut from a gall collected in Waterman Canyon in the San Bernardino Mountains. The galls were seen also at Boulevard, Ojai, and Palo Alto.

CALLIRHYTIS ATTIGUA, new species

Female.—Red, infuscated on distal half of antenna, metanotum, metapleura, propodeum, base of metacoxa; eyes and ventral valves black. Head coriaceous, face pubescent; from above transverse, broad as thorax, cheeks broadened behind eyes, occiput straight; from in front wider than high as 74:54, facial area one and three-tenths times as broad as high, malar space .38 eye, antennae filiform, 14-segmented, lengths as (scape) 16 (width 9) : 9(7.5) : 22(6) : 18 : 14 : 13 : 12 : 11 : 10 : 9 : 9(7) : 8 : 8 : 13, last pointed. Sides of pronotum finely rugose. Mesoscutum bare, coriaceous, parapsidal grooves narrow, deep, percurrent, separation behind about four times width of groove, scarcely a trace of a median behind, anterior lines smooth and shining. Scutellum rugose, two deep smooth pits at base. Carinae on propodeum bent slightly outward. Mesopleura coriaceous. Hind tarsus about two-thirds length of tibia, claws simple. Wings yellowish, pubescent, ciliate, first and second cross-veins clouded, first abscissa of radius faintly angled, areolet reaching one-ninth and cubitus seven-tenths way to basal. Abdomen equal to head and thorax, length to height to width as 32:30:19, lengths of tergites along dorsal margin as 78:21:6:5:6:3, second with sparsely pubescent areas at base and hind border and exposed parts of all other tergites coriaceous like mesoscutum. Ventral valves oblique, ventral spine slender, tapering, in side view about 5 times as long as broad.

Entire ovipositor sometimes extruded. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.1, wing 3.5, ovipositor 3.7. Length, 2.8–3.3 mm. Average of 39, 3.05 mm.

Type.—Cat. No. 27219, U.S.N.M. Type and 19 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Host.—Quercus texana.

Gall (fig. 23).—Spherical, 6–9 mm. in diameter, produced in the fall, attached to the side of the petiole just below the leaf blade and dropping when mature. They are red in color and fleshy inside without a separable larval cell.

Habitat.—The type galls were collected at Boerne, Tex., October 25, 1917, when most of the galls had already dropped to the ground under the clumps of small trees growing on the slopes of limestone hills. The galls were sent to the Eastern Field Station at East Falls Church, Va., for rearing (Hopkins U. S. No. 13686*c*) where adults emerged August 20 to September 23, 1918. Galls were also seen at Kerrville and were nearly full grown on July 21.

CALLIRHYTIS CLAVULA (Osten Sacken)

The oak club gall on *Quercus alba* has been collected at Kenilworth, Winnetka, Glencoe, Ravinia, Fort Sheridan, Waukegan, La Grange, Willow Springs, Utica, and Moline, Ill.; Miller, Ind.; Onekama (T. Hatfield), Mich.; Syracuse and Farmingdale (Crosby), N. Y.; Popular Bluff, Mo.; Plummer Island, Md.; Washington, D. C.; East Falls Church, Va., and Blue Hills, Mass. About Chicago pupae were found in the galls in various years on June 11, July 12, and July 16. One emerged July 12, 1912. At Washington living adults were cut out of galls on July 16, 1920 and in 1924 they emerged July 9, 13, and 14. Beutenmueller has had adults emerge at New York City July 14–30. Brodie collected galls at Toronto but seems not to have reared adults. Girault reared adults at Blacksburg, Va., July 12, 1901.

What seems to be the same gall has been taken on *Quercus stellata* at Mineola, Tex.; Poplar Bluff, and Washington.

CALLIRHYTIS CONGREGATA (Ashmead)

No date of emergence seems to be recorded for this species. Galls collected on *Q. wislizenii* on May 16, 1922, gave one fly June 3 and two emerged later. Galls on this host were seen at Lakeport, Upper Lake and Baird and in California Redwood Park. Galls on *Q. agrifolia* were about half-grown and secreting honeydew on May 3.

CALLIRHYTIS CORNIGERA (Osten Sacken)

The following localities are here recorded for this species: Ravina, Fort Sheridan, and Palos Park, Ill.; Miller and Chesterton, Ind.; Poplar Bluff, Mo.; DeWitt, Ark.; Mineola, Palestine, and Richmond, Tex.; Troy, Ala.; Waterford, Alexandria, and Richmond, Va.; Raleigh, N. C.; Washington, D. C.; Chesapeake Beach, Md.; Blue Hills, Mass. R. S. Walker collected a fine lot of galls near Chattanooga, Tenn.

In the Chicago area the nearly grown fresh galls in middle of May are covered with normal bark and look hard and woody, but with a knife the tissue cuts like cheese, the pinkish horns inside not quite reaching the surface, the basal part of the horn filled with translucent nutritive matter with no larval cavity evident. The tips of these horns soon break through the surface and they come to protrude a considerable distance dropping to the ground early in July. Some of these gathered from the ground in July were put in breeding cage July 16, 1917, and found to contain living adults November 26, 1917, which emerged normally May 12, 1918. If attacked by parasites these horns do not slip out. *Sesia scitula* Harris feeds on the tissue of the gall. Brodie collected galls at Toronto.

CALLIRHYTIS CRYPTA (Ashmead)

Described as forming galls on *Q. catesbaei*, similar galls determined as those of this species have been found on *Q. marilandica*, *cinerea*, and *rubra*. They have been collected at Fairfax, S. C.; Jacksonville, Gainesville, Marianna, River Junction, and St. Petersburg, Fla.; Dothan, Ala.; Laurel (M. L. Polk), Miss.; Victoria, Cuero, and College Station, Tex. At Jacksonville flies were emerging from galls on *Q. catesbaei* on April 4, 1914, and ovipositing in the internodes of the new growth.

CALLIRHYTIS DIFFICILIS (Ashmead)

The galls of this species were described from *Q. cinerea*, but they occur also on *Q. phellos*, *laurifolia*, *nigra*, and *myrtifolia*. They have been noted at Jacksonville, Daytona, Clearwater, St. Petersburg, Ocala, Gainesville, Madison, Carabelle, River Junction, Marianna, and Cottondale, Fla.; Troy and Montgomery, Ala.; Houston, Palestine, and Trinity, Tex.; Texarkana and Hoxie, Ark.; Tuskahoma, Okla.; and Poplar Bluff, Mo. Galls on *Q. phellos* at Hoxie had mostly all dropped to the ground on October 10, 1917. Kept in out-of-door breeding cage, they contained pupae August 22, 1919, and adults September 27. Some flies issued December 3, 1919, but some galls still contained larvae, and another fly emerged October 10, 1920. The emergence is thus delayed for two winters and

is then distributed over at least two seasons. Ashmead called it the "difficult gall" because he was six years in trying to rear the maker, "collecting them either too early or too late." He probably did not keep them in a suitable breeding cage long enough.

CALLIRHYTIS FLAVIPES (Gillette)

Neuroterus flavipes GILLETTE, Iowa Agr. Expt. Sta. Bull. 7, 1889, p. 281.

This species produces a fleshy midrib swelling on the leaves of *Quercus macrocarpa* in spring. Galls containing pupae were collected in Illinois at Evanston June 17, 1911, and at Winnetka June 28, 1907. Galls at Moline contained pupae June 20, 1915, and adults began to emerge June 23. From galls at Palos Park the adults had already emerged on July 2, 1917. The galls were seen also at Miller, Ind., and Brodie collected galls at Toronto. The species has previously been reported only from Ames, Iowa. The adults reared agree with paratypes in the National Museum and the species is here transferred to *Callirhytis*, where because of the very short-pubescent, non-ciliate, hyaline-veined wings, it is related to those species bred from the flowers of oak. The forest-insect collection has flies, determined by the writer as this species, reared June 19, 1915, at Falls Church, Va., from a gall on *Q. alba*.

CALLIRHYTIS FLAVOHIRTA (Beutenmueller)

Andricus flavohirtus BEUTENMUELLER, Inscut. Inscit. Menst., vol. 1, 1913, p. 124.

On July 20, 1912, the writer collected a number of these bud galls in clusters on *Q. bicolor* at the ends of the new growth on the banks of the Chicago River, west of Ravenswood, at Chicago, Ill. They were then full grown and the bracts about the galls were narrow and inconspicuous. As the bracts develop they eventually dislodge the gall and continue to grow until by fall there is a conspicuous terminal rosette of bracts. If the gall is attacked by guests or parasites, it does not drop to the ground, and when such galls are gathered in fall or winter one fails, of course, to rear the maker from them. These galls collected in July were put in a box in a terrarium in the laboratory, where by October 6 the mass moulded and was about to be thrown away when one of the galls was opened and a living adult obtained. The outer smooth fleshy layer of the gall had rotted away, leaving a hard, rough, thin brittle shell. This fly lived in a vial in laboratory until November 1. The flies probably emerge normally in the spring. This fly has been compared with the type of *flavohirtus* and seems to be the same. As the claws are simple, the species is here transferred to *Callirhytis*. These galls on *bicolor* have been seen at Evanston, Wilmette, and Ravinia, Ill.

CALLIRHYTIS FLORIDANA (Ashmead)

Andricus? floridanus ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, pp. 132, 137.

This species was described from *Q. chapmani* from Florida. As the types have the claws simple the species is transferred to *Callirhytis*. The stem swellings of this species are found in the fall covered with normal bark. They look hard and woody but when cut into they are found to consist of a thick layer of soft white parenchymatous tissue which cuts like cheese, the numerous cells being deeply imbedded next to the true wood. The writer has collected them on *Q. stellata* and reared flies which agree with the types. Galls from Poplar Bluff, Mo., contained pupae when examined in November, the adults emerging in the spring. Galls were seen also at Texarkana, Ark., and Trinity, Tex. Galls collected at Washington on April 3, 1921, had adults emerging and they continued to emerge until April 18. A moth, *Nola phylla* Dyar, whose larva feeds on the tissue of the gall, emerged April 16. W. Middleton collected galls at East Falls Church, Va., on March 14, 1920, and reared adults April 19 (Hopkins U. S. No. 14636[b]). To test the powers of flight of a Cynipid some recently emerged flies of this species were carried in a vial to a dimly lighted corridor which had a north window at the end and allowed to escape one by one at various distances from the window, on a cloudy day. One was seen to make a straight-away flight to the window at a distance of 45 feet. In 1924 the makers emerged April 26.

CALLIRHYTIS FUTILIS (Osten Sacken)

SEXUAL GENERATION

The wart galls on the leaves of *Quercus alba* have been observed at Williams Bay, Wis.; Evanston, Winnetka, Fort Sheridan, and Moline, Ill.; Cedar Rapids, Iowa; Poplar Bluff, Mo.; Tuskahoma, Okla.; Texarkana, Ark.; Elyria, Ohio; Farmingdale (Crosby), N. Y.; Rosslyn and East Falls Church, Va. Brodie collected the galls at Toronto and adults emerged July 17–29, 1893, and July 7–12, 1896. For rearing the galls should not be gathered until the producer has reached the pupa stage, which in the North would be about the first of July. The galls have been observed on *Quercus bicolor* at Evanston, Ill., and on the rock chestnut oak, *Quercus montana*, at Ithaca, N. Y., and Alexandria and Bluemont, Va. The galls were very common on the leaves of white oak about Washington in the spring of 1924.

CALLIRHYTIS GALLAESTRIATAE, new species

Female.—Black, except for the reddish-brown antennae, palpi, legs, and all the abdomen except dorsal part of second tergite. Head

covered with short white pubescence, except on vertex, finely rugose, from above as broad as thorax and broadened behind the eyes, malar space .5 eye, antennae 14-segmented, lengths as (scape) 15 (width 7) : 9 : 20(4.5) : 15 : 13 : 12 : 10.5 : 10 : 10 : 9 : 8 : 8 : 8 : 13.5(7). Pro- and mesonotum rugose, the white pubescence not quite hiding the sculpture. Parapsidal grooves narrow, percurrent, between them posteriorly several longitudinal ridges in the sculpture, but no distinct median: anterior and parallel lines inconspicuous; foveae deep, large, and distinctly separated, the septum breaking up into fine ridges running out on to disk. Carinae on propodeum nearly straight, converging slightly above. Mesopleura striate below, with small shining spot above. Wing subhyaline, pubescent, and ciliate; veins brown, the two cross-veins heavy; second abscissa of radius slightly angled; radial cell three and one-fourth times as long as broad; areolet nearly round, reaching one-eighth way to basal; cubitus reaching basal. Hind tarsus 5 shorter than 1, claws simple. Abdomen slightly longer than head and thorax, length to height to width as 35 : 28 : 20; lengths of tergites along dorsal margin as 26 : 6 : 3 : 2 : 1 : 4, second with two large pubescent patches at base; exposed parts of 3–7 punctate, seventh pubescent; ventral valves projecting posteriorly; tip of ovipositor hooked; ventral spine slender, six times as long as broad in side view, with scattered hairs below. Using width of head as a base, the length of mesonotum ratio is 1.4, antenna 2.4, wing 4.2. Length of the single specimen, 3.3 mm.

Type.—Cat. No. 27220, U.S.N.M. Holotype.

Host.—*Quercus maxima*, red oak.

Gall (fig. 24).—The gall was described by Miss Stebbins in 1910.[4] but she failed to rear the adult. The galls are spindle-shaped with a long tapering base, the largest measuring 31 mm. long by 4 mm. in diameter, longitudinally ridged with from 9–12 rounded ridges. They are found in late summer sticking out at an angle of 45° on the twigs, produced from weak lateral buds toward the base of the current season's growth, greenish at first and often tinged with red, later turning brown and dropping to ground early in September.

Habitat.—The type material was collected at Ravinia, Ill., September 15, 1917. Galls were opened at intervals and on September 2 and March 25, 1919, those opened contained full-grown larvae. On June 9, 1919, the dead adult was found in the last of the galls in the cage. Date of normal emergence unknown. These galls were also collected at Evanston, Fort Sheridan, and Glen Ellyn, Ill. William Beutenmueller has collected them at New York City. There is a similar gall on *Q. texana* at Boerne, Tex.

[4] Springfield Mus. Nat. Hist. Bull. 2, p. 23, pl. 9, fig. 34.

CALLIRHYTIS GEMMIFORMIS (Beutenmueller)

Andricus gemmiformis BEUTENMUELLER, Canad. Ent., vol. 49, 1917, pp. 346–7.

Galls of this species have been collected on *Q. alba* at Fort Sheridan, Ravinia, and Glen Ellyn, Ill., and on *Q. bicolor* at Fort Sheridan and Wilmette. Galls collected October 29, 1916, contained pupae on September 17, 1917, and adults on November 15. These would probably have emerged in the spring of 1918. From galls collected in October, 1918, living flies were cut December 2, 1919, which agree with the type. As the claws are simple the species is here transferred to *Callirhytis*.

CALLIRHYTIS HUMICOLA (Kinsey)

Andricus humicola KINSEY, Bull. Amer. Mus. Nat. Hist., vol 46, 1922, p. 283, pl. 24, fig. 13.

The gall of this species was described by the writer in 1921 as Weld 1501.[5] The next year the species was described from a single female from a gall on *Q. kelloggii* at Ashland, Oreg. The writer collected galls on this host at Siskiyou, Oreg.; and in California at Scott Bar and at Baird (where fresh galls seemed nearly full grown in late May), at Fort Jones, at Placerville, and at Milford, in Lassen County, on August 2 some cells were full of translucent nutritive matter while others contained full-grown larvae. The galls are common also on *Q. wislizenii*, being seen at Baird, Bartlett Springs, Lakeport, Ukiah, Santa Rosa, on Mount Diablo, at Los Gatos, in Palo Colorado Canyon in the Santa Lucia Mountains, in the Santa Ana Mountains, and in Waterman Canyon in the San Bernadino Mountains. In California Redwood Park galls were found at the base of sprouts which had come up about the base of stumps on the fire trail around the rim of the Big Basin and adults were already emerging on April 20; others came out April 25, 27, 28, 1922. Ten measured individuals range from 3.6–4.1 mm. Average, 3.83 mm.

CALLIRHYTIS INFUSCATA (Ashmead)

Andricus infuscatus ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, pp. 128, 144.

This species was described from Jacksonville, Fla., from galls on *Quercus catesbaei*, the adults emerging in March. As the tarsal claws are simple the species is here transferred to *Callirhytis*. The writer has collected the galls on the above host at Green Cove Springs, Marianna, River Junction, Madison, Tallahassee, Carabelle, Gainesville, Ocala, St. Petersburg, and Clearwater, Fla. Similar galls were seen at Marianna on *Q. marilandica* and *Q. cinerea* and on

[5] Proc. U. S. Nat. Mus., vol. 59, p. 243.

Q. laurifolia at Gainesville, Ocala, and Clearwater. Galls collected November 20, 1919, at Daytona on *Q. laurifolia* and sent to Washington and Evanston for rearing gave flies May 23, 26, June 3 and 15, 1920. From galls collected at Savannah, Ga., November 26, 1919, living flies were cut March 14, 1921, having pupated the previous November. Galls on *Q. myrtifolia* collected at Daytona November 20, 1919, gave flies May 23, 1920, but some galls still contained larvae as late as September 4, 1920, so that the emergence may be distributed over at least two seasons. The writer has been unable to separate these reared specimens from the types of *infuscata*.

CALLIRHYTIS LANATA (Gillette)

Dryophanta lanata GILLETTE, Bull. Ill. St. Lab. Nat. Hist., vol. 3, 1891, pp. 198–9, pl. 9, fig. 5.

This species is here recorded from two new host oaks, *Q. rubra* and *Q. texana*, and from the following localities: Evanston, Wilmette, Glencoe, Ravinia, Fort Sheridan, Waukegan, and Glen Ellyn, Ill.; Minneapolis (C. J. Weld), Minn.; Delevan (D. Watt), Wis.; North East, Pa.; Ithaca (J. C. Bradley), Riverhead (C. R. Crosby), and Medina, N. Y.; Bluemont, Va.; Poplar Bluff, Mo.; Hugo, Okla.; Palestine, Austin, and Mineola, Tex.; and Troy and Dothan, Ala. Galls collected at Evanston in fall of 1916 contained pupae and larvae on September 17, 1917, and adults and larvae on November 26. Adults issued April 6 and April 22, 1918, and about 50 more came out April 10 and April 18, 1919. These agree with the type in National Museum. As the claws are simple, the second and third tergites not tongue-shaped, the carinae on propodeum not angled, the species is here transferred to *Callirhytis*.

Brodie found the galls common about Toronto on red and black oak, forest trees as well as second growth. They appear in August, mature in October dropping before the leaves, the producers emerging May 8 and June 24, 1888, May 1, 1889, and April 4–July 24, 1898, in each case from galls collected on the ground under the trees the previous fall. Beutenmueller collected galls on red oak near Fort Lee, N. J., in October, 1922, and cut flies out of the galls in January, 1924.

CALLIRHYTIS LUSTRANS (Beutenmueller)

Andricus lustrans BEUTENMUELLER, Trans. Amer. Ent. Soc., vol. 39, 1913, p. 244.
Andricus impositus BEUTENMUELLER, Ent. News, vol. 29, 1918, p. 329.
Andricus dimorphus verifactor KINSEY, Indiana Univ. Studies 53, 1922, p. 15.
Acraspis vaccinii (gall only), ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 136.

Lustrans was described from two adults captured at Austin, Texas, gall and host unknown. One of these specimens was given in 1921 to the writer, who recognized its close relation to *impositus*. *Lus-*

trans is described as without a median groove, but this specimen in certain positions shows a faint median line, while the groove in some of the many available parataypes of *impositus* is fully as faintly defined. The writer is unable to separate paratypes of *verifactor* from *lustrans*. The gall of this species was first described by Osten Sacken in 1862, but Ashmead was evidently in error in thinking he had reared it in 1887, associating the wingless fly he reared with the wrong gall. These galls occur as midrib clusters on under side of leaves of *Quercus stellata* in the fall, dropping when mature. When fresh the individual galls are shaped like huckleberry flowers, somewhat cylindrical with the end distinctly truncate and depressed, but during the winter on the ground they become globular except for a short pedicel, and the depressed end becomes a flattened circular scar at apex with a slightly raised rim, and the greenish or reddish color changes to brown.

Beutenmueller sent the writer galls from New York City which contained pupae on November 1 and adults on November 25 (age of galls unknown). The writer collected galls at Poplar Bluff and Ironton, Mo.; Wharton, Trinity, Arlington, and Boerne, Tex.; Hugo, Okla. At Hugo they were just starting to develop on July 25. Galls collected in October, 1917, at Trinity, Tex., gave two adults May 18, 1919. In galls collected at Ironton in fall of 1917 pupae were found in October, 1918, and in March, 1919, flies emerging before May 12, 1919. S. A. Rohwer collected galls at Ironton in October, 1918, and reared adults April 9–16, 1919, and a few more were found dead in cage May 12, 1920 (Hopkins U. S. No. 10777*j*).

A precisely similar gall on the shin oak, *Q. breviloba*, was seen at Austin and Boerne, Tex., and may prove to be that of this species.

CALLIRHYTIS MAMILLAFORMIS, new species

Female.—Reddish-brown, the head, antennae, anterior and lateral lines, and dorsal part of abdomen infuscated (in the type the abdomen is a clear dark red). Head coriaceous, pubescent on face; from above transverse, as broad as thorax, cheeks scarcely broadened behind eyes; from in front facial area one and one-fifth times as broad as high, malar space 0.37 eye, without grooves, antennae 13-segmented, lengths as (scape) 16:6:18:15:13:11:9:8:7:7:7:7:7:16. Thorax covered with white pubescence, mesoscutum coriaceous with uniformly distributed setigerous punctures, parapsidal grooves narrow, deep, smooth, percurrent, well-separated behind, no median. Scutellum rugose the two oblique smooth pits at base almost confluent. Carinae on propodeum straight and parallel. Mesopleura with large smooth bare area. Hind tibia longer than tarsus, claws simple. Wing hyaline, pubescent, ciliate, veins beyond second cross-vein pale,

areolet reaching about one-sixth way to basal, cubitus indistinct. Abdomen longer than head and thorax, length to height to width as 27:23:17, length of tergites along dorsal curvature as 53:18:9:5:6:4, ventral spine long, slender, in side view eight times as long as broad. Using width of head as a base, the length of mesonotum ratio is 1.3, antenna 2.5, wing 4.1. Length, 1.8–2.1 mm. Average of four, 2.1 mm.

Type.—Cat. No. 27221, U.S.N.M. Paratypes in American Museum and Field Museum.

Host.—*Quercus alba.*

Gall (fig. 25).—A bud gall half protruding beyond the bud scales, produced in the fall and probably dropping to the ground when mature. Somewhat globular with a nipple at apex, green or brownish, smooth, truncate at base when detached without circlet of white hairs.

Habitat.—The type specimens were from galls collected at Ravinia, Ill., from terminal buds on vigorous sprouts from stumps, October 22, 1916, and four living flies cut from the galls November 16, 1917, would probably have emerged in the spring of 1918. The galls have also been seen at Bluemont, Va., and Washington, D. C. A similar gall has been observed on *Q. stellata* at Poplar Bluff, Mo.; Hoxie, Ark.; and College Station, Tex., but not yet reared.

CALLIRHYTIS MILLERI Weld

Since describing the species the writer has collected affected acorns on *Q. agrifolia* at Ojai (flies emerging April 26), Calistoga, and on Mount Diablo; on *Q. kelloggii* at Calistoga, Baird, Milford, Kyburz, Placerville, and in Santa Lucia Mountains; on *Q. wislizenii* in the Santa Ana Range, on Mount St. Helena, at Lakeport, Ukiah, Santa Rosa, Shasta, and Red Bluff, Calif.

CALLIRHYTIS MODESTA (Osten Sacken)

This hard parenchyma gall on leaves of red oak, *Q. maxima*, was collected at Ames, Iowa; Moline, Ill.; Evanston, Ill. (adults emerging June 24, 1912); Chesterton, Ind. (containing adults nearly ready to emerge June 25).

CALLIRHYTIS NIGRAE (Osten Sacken)

The writer has collected galls of this species on *Q. marilandica* at Ironton, Mo., Hot Springs and Texarkana, Ark., but never reared adults.

CALLIRHYTIS OPERATOR (Osten Sacken)

The acorn pip galls of the agamic generation have been collected at Blue Hills, Mass., and Riverhead (Crosby), N. Y., on *Quercus*

ilicifolia; at Medina, N. Y., Ironton, Mo., and Bluemont, Va., on red oak, *Q. maxima;* at Ithaca, N. Y., Webster Groves and Ironton, Mo., and Washington, D. C., on *Q. velutina.* The writer has never been able to rear adults which emerge from the galls the second spring. Brodie collected galls at Toronto.

The woolly galls on the staminate flowers of the red oaks, yielding the sexual generation, were seen on *Q. coccinea* at Miller, Ind., where adults were emerging and females ovipositing in the 1-year-old acorns. In 1913 the larvae had not begun to pupate on May 25 and adults issued in breeding cage June 15–28. In 1912 females were seen ovipositing in immature acorns on June 26. The galls were seen also at Evanston, Ill. Crosby collected galls on *Q. ilicifolia* at East Hampton, Long Island, from which adults emerged June 21. Galls have been seen on red oak at Rosslyn, Va. The writer determines as this species a lot of flies from Halifax, Nova Scotia, reared July 10, 1913.

CALLIRHYTIS PHELLOS (Osten Sacken)

The writer has collected galls of this species on *Q. imbricaria*, a previously unrecorded host, at Rosslyn, Va., June 25, 1923, and adults emerged June 26 and 28. Similar galls, containing pupae, were taken at same locality on *Q. phellos* on May 14 and living adults cut out June 20. These galls are terminal enlargements of the new growth and scarcely noticeable in June, being green and only about 5 mm. in diameter. When cut open they show a central cell surrounded by short radiating fibers. For rearing they must be left until at least the pupal stage is reached, and even then the drying out of the gall may so harden the tissues that it will be necessary to cut out the adult. If attacked by guests or parasites, and perhaps even after the escape of the maker, the galls continue to increase in size up to a diameter of 8–10 mm., lose the narrow radiating layer inside, become woody and covered with normal bark, and then are quite conspicuous and frequently collected.

Galls have been collected at Blue Hills, Mass.; Riverhead (Crosby) and Farmingdale (Crosby), N. Y.; Chesapeake Beach, Md.: Washington, D. C.; Falls Church, Va.; Daytona, Clearwater, Ocala, Gainesville, Marianna, and Tallahassee, Fla.; Palestine, Austin, Boerne, and Kerrville, Tex.; and Poplar Bluff, Mo.

CALLIRHYTIS PIGRA (Bassett)

At Evanston, Ill., these galls on *Q. velutina* and *coccinea* contained adults September 3, 1906; at Poplar Bluff, Mo., contained pupae September 6, 1915. Said to emerge in autumn or next spring. Brodie collected galls at Toronto on two occasions on small second-growth trees of red oak, *Q. maxima*, and states that many producers of both sexes emerged October 7–24, 1888, and October 10–16, 1892.

CALLIRHYTIS PULCHRA Bassett

These flower galls have been collected at Evanston, Winnetka, Fort Sheridan, and Willow Springs, Ill., on *Q. coccinea*, a previously unrecorded host, and at Wilmette on red oak, *Q. maxima*. They drop to the ground about the last of May after the aments have shed their pollen and are drying up. Flies issued June 6, 1911, June 10–24, 1912, and before June 16, 1913. Galls were seen on *Q. velutina* at Falls Church, Va.

CALLIRHYTIS PUNCTATA (Bassett)

Galls were collected at Michigan City, Ind.; Evanston, Ill.; Poplar Bluff, Mo.; Texarkana, Ark.; Mineola and Palestine, Tex. S. A. Rohwer collected galls at Ironton, Mo., in October, 1918, from which flies emerged April 16, 1919. The species transforms in the fall as adults have been cut out of galls in December and once as early as September 6. Brodie collected galls at Toronto.

CALLIRHYTIS RUGOSA (Ashmead)

Described from *Q. laurifolia*, the writer has taken galls of this species on *Q. phellos* at Gainesville, Ocala, and Tallahassee, Fla.; on *Q. imbricaria* at Rosslyn, Va.; and on red oak, *Q. maxima*, at Palos Park and Ravinia, Ill.; Plummer Island, Md.; and Rosslyn, Va. Schradieck collected galls on *Q. maxima* at East Hampton, N. Y., and Barlow on *Q. imbricaria* at Cadet, Mo. A gall from Long Island contained a pupa on June 15, and one from Chicago area contained a pupa on July 2. No adults reared. The gall is much rarer in the North than in the South.

CALLIRHYTIS RUGULOSA (Beutenmueller)

Andricus rugulosus BEUTENMUELLER, Canad. Ent., vol. 43, 1911, p. 211.

Galls of this species have been taken in May at Winnetka, Ravinia, Glencoe, and Fort Sheridan, Ill.; Miller, Ind.; Falls Church, Va.; and Washington, D. C., on *Q. coccinea*. The greenish young galls secrete honey dew, which attracts ants. Later they often become straw-yellow with rosy longitudinal streaks on the ridges, the surface showing scattered stellate hairs and with a slight nipple and crown of reflexed hairs at apex. Galls collected at Miller on May 19, 1917, gave flies before May 16, 1918, the larvae transforming to adults in the fall before middle of November. The galls have been seen just starting at Washington as early as April 24.

CALLIRHYTIS SCITULA (Bassett)

Galls of this species were collected at Winnetka and Fort Sheridan, Ill., and at Chesterton, Ind., on *Q. coccinea*. Adults of both

sexes emerged July 3, 1912, and May 22, 1913. Osten Sacken collected galls at New Rochelle and Barrytown, Zabriskie at Nyack and Flatbush, N. Y.; Thompson at Woods Hole, Mass. The writer has collected a similar gall on *Q. imbricaria* at New Lenox, Ill., Rosslyn and Bluemont, Va., and at Washington, D. C.

CALLIRHYTIS SEMINATOR (Harris)

Galls of this species are here recorded on *Quercus alba* from the following localities: Williams Bay, Wis.; Fort Sheridan, Glencoe, Evanston, La Grange, Glen Ellyn, Willow Springs, Kankakee, and Utica (Starved Rock Park), Ill.; Cedar Rapids (Scott), Iowa; Miller and Porter, Ind.; Poplar Bluff, Mo.; Texarkana, Ark.; Tuskahoma, Okla.; Troy, Ala.; Fairfax, S. C.; Richmond, Rosslyn, Alexandria, and Bedford County (Apple Orchard Camp), Va.; Plummer Island (McAtee), Md.; Gettysburg, Pa.; Ithaca, Industry (Crosby), East Hampton (Crosby), and Farmingdale (Crosby), N. Y. At Evanston the galls were found just starting on May 17 and adults issued June 29–July 12. At Washington the galls start to develop early in April. Middleton reared adults at Falls Church, Va., June 13, 1913, June 13, 1914, and June 18–29, 1915. Galls from Kanawha Station, W. Va., collected by Hopkins gave adults June 21–25, 1912. The writer has seen the gall on the rock chestnut oak, *Q. montana*, at Falls Church, Va., and on the basket oak, *Q. prinus*, at Gainesville and Jacksonville, Fla., the latter host being previously unrecorded for this species.

CALLIRHYTIS SEMINOSA Bassett

Galls like the Bassett types have been collected on *Quercus palustris* at East Falls Church, Va., but no adults were reared. Zabriskie collected a gall on the same host at Nyack, N. Y. Beutenmueller has taken it in Bronx Park, New York City, on red oak, *Q. maxima*.

CALLIRHYTIS TUBICOLA (Osten Sacken)

The galls of this species start to develop late in July and become full grown during September. The writer has observed them on *Quercus stellata* at Poplar Bluff and Ironton, Mo.; Hugo and Tuskahoma, Okla.; College Station and Trinity, Tex.; East Falls Church and Clarendon, Va., and Washington, D. C. Galls collected in October, 1917, at Ironton gave adults May 16, 28, and June 8, 1918. Galls at College Station contained pupae on November 1, 1917, and adults issued May 11, 16, 26, 28, 1918. Galls at Clarendon contained adults November 29, 1923, which emerged indoors March 1, 1924. S. A. Rohwer collected galls at Ironton in October, 1918, and reared adults (at Washington) April 9, 16, 26, 1919 (Hopkins U. S. No. 10774*f*).

CALLIRHYTIS TUMIFICA (Osten Sacken)

This large, smooth fleshy swelling of base of midrib and petiole of red oak, *Quercus maxima*, was collected at Evanston, Ill., on June 28, the adults emerging during July. At Apple Orchard Camp in Bedford County, Va., they were merging July 1, 1920. The galls have also been observed at Rosslyn, Va., and Washington, D. C.

CALLIRHYTIS VENTRICOSA (Bassett)

Cynips q. ventricosus BASSETT, Proc. Ent. Soc. Phila., vol. 3, 1864, p. 681.
Cynips q. conifera ASHMEAD, Trans. Amer. Ent. Soc., vol. 9, 1881, Proc. p. XXVII.

Bassett's galls were collected at Waterbury, Conn., on *Quercus ilicifolia* in June and the insects cut out of the galls in October "else they would probably have remained until spring." The writer has collected galls which agree with Bassett's description and types on several red oaks: On *ilicifolia* at Blue Hills, Mass.; on *coccinea* at Miller, Ind.; Evanston, Winnetka, Ravinia, and Fort Sheridan, Ill.; on *rubra*, at East Falls Church, Va.; Washington, D. C., Fairfax, S. C., and Dothan, Ala.; on *imbricaria* at Joliet and New Lenox, Ill., and Waterford and Rosslyn, Va. The galls are green, fleshy, densely short-pubescent, with a broad base and tapering apex, growing often on scar tissue on the main trunk as well as on the smaller branches. In the Chicago area they may be found developing in June, turning brown and dropping off about the middle of July. They are often eaten into by squirrels or woodpeckers. About Washington galls have been seen just starting in late March, becoming full grown by middle of May and dropping in early June. They seem to be nowhere common. Although easiest found during the developing stage they should not be gathered for rearing until they turn brown or begin to drop. From galls on *imbricaria* gathered from ground in June at Rosslyn living adults were cut out October 9. A *Q. rubra* gall from Dothan contained a pupa December 6 which transformed by December 12. Date of emergence in spring not determined.

The type galls of *conifera* Ashmead are smaller and were collected in Florida in April after they had turned brown on *Q. phellos* and *laurifolia*. The fly was cut out of a dried gall. The galls were said to issue from bud axils, but the writer found galls at Jacksonville on *phellos* like the types which were not bud galls but burst out through the bark singly or in clusters of two or three in the internodes, and some were already turning brown on April 4. The flies never emerged from these galls, but dead ones agreeing with the type were cut out in June of the next year. These galls were also seen on *phellos* at Carabelle and Lake City, Fla., and at Clarendon,

Va. They were seen on *laurifolia* at Clearwater, Fla. A Lake City gall contained a pupa on December 6, and two adults emerged May 23, giving a date for the normal emergence. The flies from *phellos* galls from Florida do not seem to differ from those reared from the larger galls on *imbricaria*, *rubra*, and *coccinea* in the north, and so *conifera* is here made a synonym of *ventricosus*. As the tarsal claws are simple, the species is transferred to *Callirhytis*, to which it would run in the Dalla Torre and Kieffer key. Brodie collected galls at Toronto which the writer would determine as this species, the host oak not recorded.

AMPHIBOLIPS ACUMINATUS Ashmead

This species was described but briefly from a single female. Some additional notes are here given and a description of the male.

Female.—Black, abdomen red, fore and middle tibae and tips of their femora not infuscated. Head rugose; antennae 13-segmented, last incompletely divided by transverse groove. Thorax coarsely rugose; parapsidal grooves rugose, percurrent, no distinct median, the anterior lines fine and parallel. Pits on scutellum large, shallow, bottom shining but sculptured, separated by a distinct septum; disk rugose, its median groove not deep. Mesopleura finely rugose. Wing pubescent and ciliate, clear except for heavy black cloud on basal half of radial cell above the small areolet. Basal vein heavy. Cubitus reaching basal. Abdomen smooth and polished, second tergite bare, occupying over .8 of abdomen. Ventral spine four times as long as broad in side view. Length of four specimens, 4.3–5.0 mm.

Male.—Differs from female in having 15-segmented antennae; third segment longest and slightly bent and stoutest, the flagellum tapering to tip. Abdomen black, smooth, and polished, and bare, except for slight pubescence on seventh tergite. Size, 3.2–4.0 mm.

Described from five specimens: Washington, D. C., 1921 (H. S. Barber); Alexandria, Va., June 11, 1923; reared from a gall collected June 3; and June 29, 1924.

Gall.—A bud gall to be found just starting about Washington from mid-April to early May. The young galls are red. They soon become greenish with a grayish bloom and often with wine-colored spots. The larvae become full grown and change to pupae in early or mid-June, when the galls begin to turn brown. Adults emerge June 11–24. The galls are heavily parasitized.

Host.—*Quercus cinerea*, and *rubra*, the Spanish oak. It was described as from the black-jack oak on which the writer has never found it as yet.

Habitat.—The gall is common on the coast plain region near Washington on *Q. rubra*. Farther south it occurs on *Q. cinerea* also. The writer has also seen galls at Ocala, Cottondale, Mari-

anna, River Junction, and Madison, Fla.; at Dothan, Ala.; at Fairfax, S. C.; at Fredericksburg and East Falls Church, Va.; at Chesapeake Beach, Md.; at Palestine, Mineola, and Trinity, Tex.; and at Hugo, Okla. Dr. J. C. Bradley collected galls in Georgia and A. B. Gahan at Berwyn, Md.

AMPHIBOLIPS CINEREA (Ashmead)

The writer has collected galls on *Q. cinerea* at the following Florida localities: Jacksonville, Gainesville, Ocala, St. Petersburg, and Madison. The National Museum has some from Brooksville and from "Georgia." At Gainesville April 23, 1914, the flies were about ready to emerge and a supply was secured by cutting open the galls. Some galls were noticed in which was a little hole as though a parasite had recently issued. When one of these was cut open a small chalcid was found inside among the fibers and a living producer in the central cell. It soon became evident that the chalcid was chewing a way in instead of out in order to attack the maker even after it had completed its transformations. Fragments of adults inside the cell frequently showed that the dangers of parasitism are not entirely over until the maker actually gets out of the gall.

AMPHIBOLIPS CITRIFORMIS (Ashmead)

This species was described from *Q. phellos* from "Florida," the adults emerging the first week in May. The type galls are bud galls. The writer has collected galls at Jacksonville and Daytona but never reared the flies.

AMPHIBOLIPS COELEBS (Osten Sacken)

As this species has been known from a single male from a gall on the red oak, *Q. maxima* at Washington a description is here given of the female from a gall on the same oak and from nearly the same locality.

Female.—Head nearly black; thorax, legs, antennae, mandibles, and abdomen red, the latter infuscated posteriorly. Head narrower than thorax, rugose with fine radiating ridges on malar space, antennae 13-segmented, filiform, face slightly pubescent. Thorax covered with pubescence not dense enough to obscure the sculpture. The indistinct median and parapsidal grooves rugose like rest of mesoscutum, separation between parapsidal grooves behind not greater than width of groove. Disk of scutellum reticulate, scarcely grooved in median line, two pits at base. Pleurae rugose. Wing subhyaline with first cross-vein heavy and a heavy cloud in base of the radial cell and about the indistinct areolet, cubitus reaching basal. Legs without infuscation, claws with tooth. Abdomen not quite as long as head and thorax, lengths of tergites along dorsal curvature as

98:20:9:3:0:7, second smooth at base and with slightly pubescent areas on sides, exposed parts of rest microscopically punctate except for a narrow smooth and polished hind margin. Ventral valves directed backward, ventral spine tapering, pubescent underneath, about as long as first segment of hind tarsus. Using width of head as a base the length of mesonotum ratio is 1.4, antenna 2.4, wing 3.6. Length of three specimens, 3.5, 3.7, 3.8 mm.

Two of the above specimens were reared July 13 and 24, 1914, by W. Middleton from galls on *Q. maxima* collected at Falls Church, Va. The third was from a gall collected June 15, 1914, by H. E. Schradieck at East Hampton, Long Island, the fly emerging before July 20. He also sent galls from Riverhead, Long Island. The writer has collected galls at Blue Hills, Mass., and also at Washington on *Q. velutina*.

AMPHIBOLIPS CONFLUENTUS (Harris)

Galls at Ithaca, N. Y., contained full-grown larvae on July 14, 1908, when collected, pupae on August 1 and adults September 12 when 86 specimens, all females, were cut out of the galls. A gall at Waterport, N. Y., contained a pupa August 14. Galls at Manistee, Mich., contained adults when opened September 20. At Miller, Ind., galls just turning brown were gathered on June 3, 1911, then containing full-grown larvae which had transformed into adults by September 16. Flies emerged on November 21, 1918, from galls on *Quercus velutina* from Lyme, Conn. (Hopkins U. S. No. 10767[b]). Brodie collected galls on *Quercus coccinea* at Toronto in October and producers emerged November 10, 1892, all females.

AMPHIBOLIPS SPONGIFICA (Osten Sacken)

At Washington, which is the type locality for this vernal sexual form, the galls appear with the leaves in the spring, having been observed on April 24, 1921, 3 cm. in diameter when the leaves were scarcely 15 mm. wide. In 1923 they were full grown by May 6, but with the nutritive layer only partly used up. One contained a living male ready to emerge on June 16. At Porter, Ind., galls were beginning to turn brown on June 19, 1912, and a male issued July 1. At Evanston, Ill., males and females issued June 16 and 20, 1913. Galls collected June 16, 1918, on *Q. coccinea* at Lyme, Conn., gave adults of both sexes June 12, 21, 29, 1918 (Hopkins U. S. No. 10767[a]). Flies emerged from galls from Rosslyn, Va., on June 12–14. Brodie collected galls at Toronto on *Quercus maxima*. "They appear as an expansion of the leaf early in May, always attached to the end of a vein. Ova placed in bud in fall." Adults all out by end of June, 1886, and in 1887, he records that the producers had nearly all emerged by July 3, and in 1893 all out by July 1.

AMPHIBOLIPS COOKII Gillette

The following additions to the published distribution data for the species are here made: Ithaca and Medina, Atwater (Howe), West Point (Osten Sacken), Katonah (Beutenmueller), N. Y.; Evanston, Ravinia, Waukegan, Kingston, Willow Springs, and Moline, Ill.; Kilbourn, Wis., where the galls were so common in the fall of 1908 that over 800 were collected; Poplar Bluff and Ironton, Mo.; Tuskahoma, Okla.; and Bluemont, Va. Brodie collected galls at Toronto. In the fall of 1887 he put 187 galls on the ground in garden where they lay all winter and the next summer. The adults "began to come out October 25, 1888, fifty specimens in all, some alive and ovipositing on December 1. They oviposit in buds, the female surmounting the bud and grasping it with all her feet, pushing the ovipositor between the scales of the bud." He did not find a male. His notes describe the gall as nearly spherical, 11–23 mm. in diameter, yellowish-green, thickly dotted with slightly elevated reddish-brown spots. They may there be collected on ground after middle of September usually under trees of large size. The National Museum has galls from Elkhart, Ind.

AMPHIBOLIPS ELLIPSOIDALIS, new species

Female.—Head and thorax black, abdomen dark red, antennae, mandibles, legs beyond femora brownish. Head rugose, pubescent, not as broad as thorax, from above transverse, occiput concave, cheeks greatly broadened behind eyes; from in front broader than high, as 32:26, facial area square, malar space half eye, antennae filiform, 15-segmented, lengths as (scape) 21 (width 10):11(8.5):36(7):23:18:16:12:11:10:9:9:9:8:8:15(8). Thorax and legs with white pubescence, dense and erect on sides of the rugose pronotum, closely appressed on mesoscutum, but not hiding sculpture. Mesoscutum rugose in low relief, the tops of ridges shining; parapsidal grooves reaching forward to hind end of the fine anterior parallel lines, lateral lines wider than anterior, a slight trace of a median line in the sculpture. Scutellum rounded behind, with two smooth oblique pits at base distinctly separated by a septum which is continued back as a median carina in the sculpture of the broad rugose disk. Carinae on propodeum straight, converging slightly above. Mesopleura with a small bare polished spot. Legs stout, hind tibia longer than tarsus, its segments as 45:22:14:9:27 (with claw 33). Claws toothed. Wing slightly dusky, pubescent, ciliate, subcosta, and two cross-veins clouded, free part of subcosta not reaching margin, second abscissa of radius angled, areolet reaching one-fifth way to basal, cubitus reaching basal. Abdomen not as long as head and thorax, length of tergites on dorsal margin as 43:5:2:1.

second with large pubescent areas on sides, hind margin at angle of 45°, ventral valves oblique, ventral spine slender, tapering, pubescent underneath, in side view about five times as long as broad. Using width of head as a base, the length of mesonotum ratio is 1.34, antenna 1.7, wing 3.4. Length of the single specimen, 5.3 mm.

Type.—Cat. No. 27222, U.S.N.M. Holotype.

Host.—*Quercus palustris.*

Gall (fig. 26).—A bud gall of early spring as new growth is starting. Spindle-shaped, blunt at both ends, up to 14 mm. long by 5 mm. in diameter, smooth, mottled with white when fresh, falling to ground when mature. Produced from weak lateral buds.

Habitat.—The type fly was reared from a gall collected May 9, 1920, on *Q. palustris* at "Dyche" on the wooded banks of the Potomac below Alexandria, Va. The fly was found dead in breeding cage April 10, 1921. Similar galls have been found in spring on *Q. coccinea* at Ravinia and Fort Sheridan, Ill.; Miller, Ind.; and Washington, D. C. A shorter and broader gall with the same structure was seen on *Q. imbricaria* at Joliet, Ill.

AMPHIBOLIPS ILICIFOLIAE (Bassett)

Crosby and Schradieck collected galls on *Q. ilicifolia* at Riverhead and East Hampton, Long Island, on July 20, from which all but one of the flies had already emerged. Probably the normal emergence period is late June or early July.

AMPHIBOLIPS INANIS (Osten Sacken)

The "empty oak apple" has been collected at the following localities: Evanston, Lake Zurich, Glen Ellyn, La Grange, New Lenox, Joliet, Palos Park, Willow Springs, and Moline, Ill.; Porter, Ind.; Manistee and Onekama (T. Hatfield), Mich.; Delevan (D. Watt), Wis.; Ironton, Mo.; Tuskahoma, Okla.; Plummer Island, Md.; Apple Orchard Camp, in Bedford County (C. J. W.), and Bluemont, Va.; Blue Hills, Mass.; Medina and Ithaca, N. Y.; and Ottawa (F. Johansen), Canada. Brodie collected galls at Toronto.

The galls are 18–32 mm. in diameter, light green with irregularly scattered purplish spots, wall thin and somewhat translucent, produced singly on under side of leaf. At Evanston adults issued in various seasons on June 25, June 11, July 6; at Ottawa, July 8; in mountains of Virginia on July 9.

AMPHIBOLIPS NIGRA Beutenmueller

This species, whose gall was described as on an unknown oak in Durango, Mexico, occurs in Arizona where the writer has collected galls on *Quercus emoryi* and *Q. hypoleuca* in Huachuca Mountains,

near Bisbee in Mule Mountains, and in the Santa Catalina Mountains. The National Museum has galls from the Santa Rita and Chiricahua Mountains and from Fort Grant. The writer has not reared adults. Seventeen of the types range from 5.2–6.3 mm. Average 5.6 mm.

AMPHIBOLIPS NUBILIPENNIS (Harris)

This species forms a fleshy translucent yellowish-white gall resembling a green grape attached to the under side of leaf in spring. A gall on *Quercus coccinea* at Miller, Ind., contained a pupa on May 30 and another found June 30 showed an exit hole where the maker had recently escaped. Galls were seen on red oak, *Q. maxima*, at Fort Sheridan, Ill., and at Indian Falls, N. Y. Crosby collected a lot of fresh galls 10–22 mm. in diameter at Farmingdale, N. Y., on June 14, 1914, on *Q. coccinea* and *velutina* and from these a male issued June 22, another June 23, and two females June 24, and one June 25. Four-fifths of the galls were parasitized.

AMPHIBOLIPS RACEMARIA (Ashmead)

This species was described from females from "Florida" on *Q. laurifolia*. The types are labeled "Jacksonville" and with them is a male of a subsequent rearing determined by Ashmead. The writer collected galls on *Q. laurifolia* at Daytona, Clearwater, and Ocala; also on *Q. phellos* at Jacksonville, Carrabelle, and Gainesville, rearing one adult, a female, some time after April 23. The flies are closely related to *nubilipennis* (Harris) and a comparison of a larger series of specimens may show that it is not worth while to maintain the name *racemaria* for individuals attacking southern oaks. There is a similar gall on *Q. nigra* at Texarkana, Ark., and on *Q. imbricaria* about Washington but no adults have been reared.

AMPHIBOLIPS SPINOSA Ashmead

This species was described from one specimen from "Florida" reared in January, the gall on *Q. laurifolia*. The writer has found the gall on *Q. phellos* also and at the following localities: Jacksonville, Daytona, Live Oak, Madison, River Junction, Tallahassee, Gainesville, and Clearwater. Among galls collected on ground at Madison on October 21, 1919 some contained pupae but the adults never emerged. When the galls were cut open October 10, 1920 moulded adults, a pupa and a larva were found. These adults were females.

AMPHIBOLIPS TINCTORIAE Ashmead

Galls on *Q. velutina* have been collected in the fall at Poplar Bluff, Mo.; Moline, Ill.; and Washington, D. C. The type flies emerged October 16, locality unknown. The writer has never reared adults.

BASSETTIA CEROPTEROIDES (Bassett)

A gall agreeing with the Bassett type galls of this species was collected at Miller, Indiana, on *Quercus coccinea* on May 19, but the adults had escaped.

BASSETTIA GEMMAE Ashmead

The species was described from flies taken ovipositing in buds April 27, at Cadet, Mo. Gall unknown. The writer captured flies agreeing with the types ovipositing in the buds of *Q. alba* at Clinton, Ill., April 21, 1916, Evanston, Ill., April 9, 1910, Washington D. C. March 27, 1920, April 24, 1921, April 15, 1924.

BASSETTIA TENUANA Weld

Galls collected on *Q. undulata* at foot of bluff 17 miles east of Hillsboro, N. Mex., on November 14, 1921, contained adults and living flies were cut out of the galls on January 13 and February 6, 1922. Galls were collected on *Q. fendleri* at Las Vegas, October 17, 1921, some containing adults and others larvae. At Shoemaker on October 23, 1922, on *Q. gambelii* some contained living adults and others were partly grown with a thick translucent nutritive layer in the cells.

EUMAYRIA HERBERTI, new species

Female.—Red, eyes and ventral valves black. Head and thorax opaque, the sculpture apparently coriaceous but the polygonal areas are bounded by ridges. Head from above broader than thorax, massive, occiput slightly concave; from in front face pubescent, malar space .46 eye without groove, antenna 13-segmented, lengths as (scape) 15 (width 6) : 7(5.5) : 11(4) : 10 : 9 : 9 : 9 : 8 : 8 : 8 : 8 : 7 : 15(5), flagellum gradually becoming stouter toward apex. Parapsidal grooves smooth, deep, percurrent, wider behind with a trace of a median. Mesocutum broader than long. Scutellum with two large deep smooth pits, the sculpture on disk becoming coarser behind. Carinae on propodeum straight and parallel. Hind tarsus shorter than tibia, segments as 28 : 7 : 5 : 3 : 9, claws simple. Wing hyaline, covered with very short brown pubescence, margin not ciliate, veins very pale, first abscissa of radius arcuate, no areolet. Abdomen as long as head and thorax, lengths of tergites along dorsal curvature as 52 : 7 : 4 : 4 : 3 : 6, second with interrupted ring of wool as base, hind margin not oblique, ventral valves oblique and protruding, ventral spine slender and in side view 8 times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.2, antenna 2.3, ovipositor 3.3, wing 3.8. Length, 1.9–2.4 mm. Average of 75, 2.17 mm.

Types.—Cat. No. 27223, U.S.N.M. Type and 39 paratypes. Paratypes in American Museum, Field, Stanford, Harvard, California Academy, and Philadelphia Academy.

Host.—Quercus kelloggii.

Gall (fig. 27).—Cells in the peripheral layer of wood just under the normal bark of vigorous shoots 2 cm. or less in diameter. Single cells measure 3 mm. by 1 mm., the long axis parallel with long axis of twig, the exit holes .7 mm. in diameter. If several cells lie close together their shape is somewhat distorted and a slight swelling may be visible on surface.

Habitat.—The type material was collected at Placerville, Calif., May 7, 1918, by Mr. Frank B. Herbert; adults emerging May 21–27 and June 7, 1918 (Hopkins U. S. No. 13687*d* and 15608*c*). The writer collected galls at Los Gatos, in Palo Colorado canyon in the Santa Lucia range, and in the Sequoia National Park near Colony Mill.

The same sort of cells were noted in the twigs of *Q. agrifolia* at Boulevard, Pasadena, Soledad, Monterey, Los Gatos, Berkeley, and Santa Rosa; and in twigs of *Q. wislizenii* at Idyllwild, Camp Baldy, and Santa Margarita.

Genus SAPHONECRUS Dalla Torre and Kieffer

No species of this genus has hitherto been described from the Philippines. As the known species of this genus are guests in Cynipid galls on oak, the finding of these guests makes it certain that such galls occur in the islands but none has as yet been reported.

The only described species of the genus from the United States is *Saphonecrus gemmariae* (Ashmead) from Florida. It was described from male bred from gall of *Callirhytis gemmaria* (Ashmead) and the type seems to be lost.

A key is given below to the three species here described.

1. Areolet absent ..... **serratus** Weld.
   Areolet present ..... 2.
2. Radial cell three times as long as broad. Median groove evident posteriorly ..... **areolatus** Weld.
   Radial cell twice as long as broad. No median ..... **brevis** Weld.

SAPHONECRUS BREVIS, new species

Female.—Vertex, eyes, tips of mandibles and part of occiput black, rest of head honey-yellow, darker in some individuals than in others. Sides of pronotum lighter yellow, median dorsal area black. Pectus black, the mesopleura more or less infuscated, showing much variation in different individuals. Metapleura, propodeum, mesonotum, and abdomen black. Parts of coxae black, femora more or less infuscated dorsally, other parts of legs yellow.

Vertex coriaceous with scattered punctures. Cheeks broadened behind eyes. Malar space .56 eye, radiating ridges above mouth. Antenna 14-segmented, lengths as (scape) 17 (width 7) : 8(5) : 16(4) : 10 : 10 : 10 : 9 : 9 : 8 : 8 : 8 : 7 : 7 : 11(4). Pronotum "broad," one-fifth as long in middle as on sides, rugoso-punctate, slightly pubescent. Mesoscutum broader than long, with discontinuous sharp transverse ridges, the intervals rather smooth and shining; parapsidal grooves narrow, percurrent, crossed by the ridges anteriorly, the enclosed area rounded behind, no median; anterior and lateral lines fine but distinct. Scutellum rugose, disk faintly margined behind, no distinct pits at base. Carinae on propodeum broad, straight, diverging above. Hind tibia longer than tarsus whose segments are as 36 : 14 : 8 : 5 : 13, claws simple. Wing hyaline, pubescent and ciliate, radial cell open, twice as long as broad, first abscissa of radius arcuate, one-third length of second, which is slightly curved, areolet reaching one-fourth, cubitus three-fourths way to basal and if prolonged would reach it slightly below the middle; veins brown.

Abdomen as long as head and thorax, length to height to width as 36 : 25 : 18, petiole stout, sulcate, second tergite bare, highly polished, longest on median dorsal line, pointed behind, slightly crackled under high magnification near tip, other tergites hidden. Hypopygium long but not conspicuous, ventral spine almost bare, in side view three times as long as broad. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 1.7–1.9, wing 2.8–3.0, ovipositor 2.9–3.1.

Length, 2.7–3.8 mm. Average of 77 pinned specimens, 3.2 mm.

Male.—Similar to female in coloration and sculpture. Antenna 15-segmented, first five segments as 15 : 8 : 17 : 9 : 10, third as stout as the second and strongly curved. Abdomen shorter than head and thorax.

Length, 2.2–3.8 mm. Average of 36, 2.9 mm.

Type.—Cat. No. 27224, U.S.N.M. Type female, allotype, 15 male and 30 female paratypes. Paratypes at American Museum, Field, Stanford, Harvard, and Philadelphia Academy.

Biology.—The type is selected from a series reared March 17, 1923, from the large abrupt woody stem galls of *Andricus ruginosus* Bassett collected at Magdalena, N. Mex., the previous October on *Quercus grisea*. Paratype material reared April 6 from the same species of galls collected in the Santa Rita Mountains, Arizona, on *Quercus oblongifolia*. Paratype material also reared from the same galls collected in Tumacacori Mountains, Arizona, on *Quercus arizonica*. The flies issued March 8 and April 5 and 20.

Determined as this species the Museum has flies from Silver City, N. Mex., reared February, 1881; Las Cruces, N. Mex., Fort Grant, Ariz., reared April 19, 1882, all from twig swellings on oak. Also flies from gall of *Andricus durangensis* Beutenmueller, Durango, Mexico, reared March 1, 1897.

SAPHONECRUS SERRATUS, new species

Female.—Black, legs, antennae, mandibles, and tegulae reddish-brown. Head from above broad as thorax, median length .35 width, occiput concave, cheeks not enlarged behind the eyes, not margined; from in front broader than high, interocular line .5 transfacial, malar space as long as eye, without groove, whole face covered with fine ridges radiating from clypeus but partially obscured by white pubescence, parallel vertical ridges on vertex above antennae on each side of median ocellus, antennae filiform, 14-segmented, lengths as (scape) 14 (width 6) : 7(5) : 16(3.5) : 14: 14: 14: 13: 12: 11 : 10: 10 : 9 : 9 : 15(3.5), maxillary palpus 5- and labial 3-segmented. Pronotum "broad" as in all the guest flies, median length one-fourth that on lateral margin, somewhat truncate in front with two small pits, emarginate behind, sides coarsely punctate. Mesoscutum broader than long, traversed by sharp transverse interrupted ridges which are higher on anterior third, parapsidal grooves are indicated in the coarse sculpture and in certain positions a median is indicated posteriorly. Scutellum subtruncate and coarsely rugose, slightly margined behind, with parallel longitudinal ridges in transverse groove at base. Carinae on propodeum straight, diverging above, enclosing a smooth area broader than high, a prominent ridge on each side also laterad of the spiracle. Mesopleurae entirely longitudinally striate. Hind tarsus shorter than tibia, segments as 37 : 10 : 7 : 6 : 15 (including claw). Claws simple. Hind tibia with the two usual apical ventral spurs and a shorter dorsal one. Fore wing pubescent and ciliate, radial cell open on margin and partially so at base and apex, cubitus reaching basal at its lower end, no areolet, anal vein clouded as far as the usual break. Abdomen shorter than head and thorax, length to height to width as 27 : 22 : 14, second tergite one-fourth as long as third much as in *Ceroptres* but the two grown together without a visible suture (determined by dissection and balsam mount), the combined plate occupying the whole of the abdomen in side view, its hind margin distinctly punctate, base almost bare; petiole short, longitudinally sulcate as in *Synergus*, ventral valves scarcely protruding, ventral spine in side view twice as long as broad. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 2.3, wing 3.4, ovipositor 3.3. Range in length 2.4–3.4 mm. Average of 18 specimens 2.8 mm.

Male.—Differs from the female in having 15-segmented antennae, filiform like those of female, length of third to fourth as 15:12, slightly flattened on outer side but almost straight. Abdomen as long as thorax, only the fused second and third tergites visible in side view.

Lenth 2.3–2.5 mm. Average of 3 specimens 3.38 mm.

Type.—Cat. No. 27225, U. S. N. M. Type female, allotype, and 7 female paratypes. One male and 7 female paratypes in collection of Prof. C. F. Baker, Los Baños. One female paratype at American Museum.

Habitat.—Baguio, Benguet, Island of Luzon in Philippines (Baker). Collected at Haight's place at 8,000 feet in mountains near Baguio. Crawling on leaves on forest floor among oaks in freezing weather. No oak galls seen.

SAPHONECRUS AREOLATUS, new species

Female.—Differs from *serratus* in the absence of vertical ridges above the antennae, in the less sharply ridged mesoscutum, the transverse ridges not being distinctly higher anteriorly, the parapsidal grooves narrow, deep and distinct, not so much lost in the sculpture, median more distinct posteriorly. The transverse groove at base of scutellum without longitudinal ridges and indistinctly divided into two pits. Fore wing with a distinct areolet reaching one-fifth way to basal. Abdomen with punctation on hind border of big tergite almost entirely wanting, visible only under high magnification, ventral valves protruding obliquely. Length of two specimens 3.1 and 3.2 mm.

Male.—Distinguished from the male of *serratus* by same differences in sculpture mentioned above for the female and also by the shorter, stouter antennae, the third segment more distinctly excised. Length of 3 specimens, 2.3, 2.65 and 2.65 mm.

Type.—Cat. No. 27226, U.S.N.M. Type female and allotype. One male and one female paratype in collection of Prof. C. F. Baker, Los Banos.

Habitat.—Baguio, Benguet, Island of Luzon in the Philippines (Baker). Collected at Haight's place with preceding species.

SYNERGUS CASTANOPSIDIS (Beutenmueller)

Periclistus castanopsidis BEUTENMUELLER, Ent. News, vol. 29, 1918, p. 251.

A paratype female in the National Museum is a *Synergus* to which genus the species is here transferred.

Genus EUCEROPTRES Ashmead

This genus was proposed in 1896 for *Euceroptres primus* Ashmead whose type female was reared as a guest in a gall on scrub oak,

Georgiana, Florida. Dalla Torre and Kieffer in 1902 and again in 1910 have made the genus a synonym of *Ceroptres* Hartig. A study of the type and of two congeneric species here described leads me to believe that the genus should be maintained and in this opinion Dr. J. J. Tavares, who has published extensively on the Cynipid guests of the Iberian peninsula and who has examined sketches showing the generic characters and specimens of one of the new species, agrees. The genus may be recognized by the long pronotum which is broadly truncated, by the absence of the two parallel ridges on the face below the antennae which Doctor Tavares says are found only in the genus *Ceroptres*, and by the character of the abdomen which is made up largely of tergites two and three whose hind margins are parallel and oblique, forming an angle of about 45° with the long axis of the abdomen; tergite two is highly polished almost bare at base and three is microscopically punctate. The petiole is short and smooth, the ventral spine very short. Radial cell closed, cubitus directed toward lower end of basal. Tarsal claws weak but toothed.

KEY TO SPECIES OF EUCEROPTRES

1. Mesoscutum smooth or coriaceous rather than rugose without more than mere suggestion of transverse sculpture. Antenna of female 13-segmented, scape only infuscated. Tergite III highly polished and under ordinary magnification without punctures. Under 2.5 mm. Eastern United States and Japan ---------- 2.
   Mesoscutum more or less rugulose with evident transverse sculpture. Antenna of female 12–14 segmented. Over 2.5 mm ---------- 3.
2. Mesoscutum smooth, parapsidal grooves obsolete, scutellum disk smooth. Segment 3 of female antenna is to 4 as 19 : 8 ------ **japonicus** (Ashmead).
   Mesoscutum coriaceous, parapsidal grooves distinct and percurrent, disk of scutellum rugose. Segment 3 of female antenna is to 4 as 9 : 8. **primus** Ashmead.
3. Antenna of female 14-segmented, all infuscated, scape nearly black. Areolet reaching one-fifth way to basal. Punctation on tergites III and IV very distinct on sides. Transverse sculpture on mesoscutum only slight. Length 1.8–3.3 mm., from galls on *Q. chrysolepis* ---**montanus** Weld.
   Antenna of female 12-segmented, scape only infuscated. Areolet reaching one-tenth to one-seventh way to basal. Punctation on tergites III and IV very fine and not conspicuous. Mesoscutum more distinctly transversely rugulose. Larger species, 2.9–4.0 mm., from galls on *Q. agrifolia*. **maritimus** Weld.

EUCEROPTRES JAPONICUS (Ashmead)

Ceroptres japonicus ASHMEAD, Journ. New York Ent. Soc., vol. 12, 1904. p. 78.

The species was described from three specimens said to be males. One of the types has been lost from the card and the two remaining are females as Dalla Torre and Kieffer suspected. They belong to the genus *Euceroptres*, to which genus the species is here transferred.

EUCEROPTRES PRIMUS Ashmead

The following notes on the types are made to supplement the original description.

Seen from above the body has a wedge shape, narrowing gradually from the head which is the broadest part of the body. Head broadest behind the eyes. Lengths of segments of female antenna as (scape) 9 (width 4) : 5(3) : 9(2.5) : 8 : 7 : 7 : 6.5 : 6 : 5.5 : 5 : 5 : 5 : 9(4.5). In the male the third is to fourth as 12 : 10 and the third is strongly excavated. The pronotum is not "narrow" in the middle as in the gallmakers but relatively long as in all the genera of guest flies, broadly truncate, the trucation not margined, however, either above or on sides. Mesoscutum broader than long, coriaceous rather than rugulose with scarcely a suggestion of transverse sculpture, median groove short, about twice as long as broad. Carinae of propodeum curved slightly outward. Radial cell closed, two and one-fourth times as long as broad, first abscissa of radius arcuate. Areolet reaching about one-fifth way to basal, its distal vein showing a break, cubitus directed toward lower quarter of basal. Middle and hind coxae each with a bare and polished area, tarsal claws with tooth. Abdomen of female in side view showing length to height as 58 : 40, the hind margins of tergites II and III being parallel and oblique, making an angle of about 45° with the longitudinal axis of abdomen, the third showing a much larger area in side view; lengths of tergites along dorsal curvature as (petiole) 2 : 34 : 20 : 6, rest not visible dorsally, tips of ventral valves projecting slightly behind, petiole smooth, second, and third bare and highly polished with a dorsal patch of fine punctures on third, scattered punctures on fourth, hypopygium punctured and pubescent, ventral spine very short. In male lengths of tergites along dorsal curvature as (petiole) 3 : 33 : 17 : 3 : 0 : 0 : 11, third faintly punctate, last plainly so and pubescent, hind margins of two and three parallel and oblique as in female.

Biology.—The types were reared March 24 and April 7 from a gall on leaves of scrub oak at Georgiana, Florida. Two paratypes which are smaller and brownish but similar in structure are from a gall on *Q. alba* from Massachusetts. A male and female of what the writer determines as this species were found among the unmounted cotype material of *Cynips cicatricula* Bassett, now regarded as a synonym of *Andricus petiolicola* (Bassett). These were from *Q. alba* at Waterbury, Conn. The writer has bred specimens from the oak petiole gall on *Q. stellata* as Rosslyn, Virginia, July 1, 1923. The National Museum has one captured at Washington July 5, and the writer captured one at Ocala, Florida, on April 17, 1914.

EUCEROPTRES MONTANUS, new species

Female.—Black, tarsi, and antenna beyond scape brownish, all femora and tibiae lighter brown. Head and thorax in certain positions showing appressed whitish pubescence. From above head is transverse, occiput concave, cheeks not broadened behind eyes; from in front broader than high, broadest above at level of antennae, malar space .57 eye without groove, antennae 14-segmented, lengths as (scape) 14(width 7) : 6(6) : 15(5.5) : 17 : 15 : 14(6) : 13 : 12 : 11 : 10 : 9 : 9 : 8 : 14(5), or 15-segmented with the last two as 7 is to 9. Sides of pronotum finely rugose. Mesoscutum broader than long, parapsidal grooves narrow, smooth, percurrent, anterior and lateral lines short and smooth, traces of median groove posteriorly, surface faintly transversely ridged. Pits of scutellum open behind on to disk which is more coarsely rugose posteriorly. Carinae on propodeum parallel, enclosing a nearly square smooth area. Mesopleura with polished bare area posteriorly. Middle and hind coxae with a polished bare spot. Hind tarsus and tibia subequal, tarsal segments as 33 : 15 : 10 : 8 : 11 (including claw 16), claws weak with a weak tooth. Fore wing pubescent and ciliate, veins brown, radial cell closed, length to breadth as 23 : 8, areolet reaching one-fifth, cubitus about one-half way to basal. Abdomen shorter than head and thorax, length to height to width as 40 : 28 : 22. Lengths of tergites measured along dorsal curvature as (petiole) 5 : 61 : 23 : 10 : 0 : 0 : 8, petiole smooth, third and fourth microscopically punctate, seventh pubescent, ventral valves projecting horizontally well beyond tergites, ventral spine very short. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 2.3, wing 3.0, ovipositor 1.5.

Range in length, 1.8–3.3 mm. Average of 58 specimens, 3.0 mm.

Male.—Differs from female in having antennae 15-segmented, lengths as (scape) 13 : 5 : 17 : 19 : 17 : 16 : 15 : 14 : 13 : 12 : 11 : 10 : 10 : 9 : 13 or 16 segmented by the division of the last into two of almost equal length, third incised, flagellum tapering gradually from about middle to apex. Abdomen shorter than thorax, length to height to width as 94 : 70 : 53. Lengths of tergites measured along dorsal curvature as (petiole) 5 : 55 : 22 : 2 : 0 : 0 : 20, petiole smooth, seventh conical with white pubescence dorsally. Length of antenna ratio, 2.7.

Range in length, 2.4–3.2 mm. Average of 48, 2.77 mm.

Types.—Cat. No. 27228, U.S.N.M. Type female, allotype, 18 female and 20 male paratypes. Paratypes in American Museum, Field, Stanford, Philadelphia Academy, and California Academy.

Biology.—Reared from gall of *Disholcaspis truckeensis* (Ashmead) on *Quercus chrysolepis*. Emerged April to June from galls collected the fall before.

Habitat.—Type locality, Idyllwild, Calif. Paratype localities: Camp Baldy, and Butte County (Big Bar Station on Western Pacific), Calif.; and Canyonville, Oreg. Determined as this species the Museum has two from Kern County, Calif., which were reared April 20, 1893.

EUCEROPTRES MARITIMUS, new species

Female.—Black, antenna beyond scape and legs beyond trochanters yellowish, tibiae and tarsi darker. Antennae 12-segmented, filiform, stout, lengths as (scape) 22 (width 9) : 8 (7) : 21 (7.5) : 21 : 18 : 17 : 16 : 13 : 10 : 9 : 8 : 20 (6.5), the last in some specimens showing a faint trace of a transverse furrow dividing it into two parts with lengths as 7 is to 13. Mesoscutum with sharp and distinct transverse ridges. Areolet reaching one-tenth to one-seventh way to basal, cubitus reaching basal at its lower end. Using width of head as a base the length of mesonotum ratio is 1.1, antenna 1.9, wing 2.9, ovipositor 2.0.

Range in length, 2.9–4.0 mm. Average of 13 specimens, 3.7 mm.

Male.—Antennae stout, 16-segmented, third excavated and equal to fourth, tapering to tip from about middle of flagellum. Lengths of tergites along dorsal curvature as (petiole) 5 : 60 : 33 : 10 : 3 : 6 : 20, the last with coarse setigerous punctures dorsally. Antennal ratio 2.25. Range in length 3.3–3.9 mm. Average of 10 specimens 3.6 mm.

Type.—Cat. No. 27229, U.S.N.M. Type female, allotype, 4 male and 4 female paratypes. Paratypes in American Museum, Field and Stanford.

Biology.—Two females and two males (including type and allotype) bred from a large woody gall of *Callirhytis suttoni* (Bassett) collected on *Q. agrifolia* on University of California campus by Mrs. G. D. Louderback, March 11, 1912. The guests emerged April 20. The paratype series also includes two males found among the Bassett cotypes of *Callirhytis suttoni* (Bassett) which was described from Oakland, and nine reared from galls determined as *Callirhytis suttoni* (Bassett) collected at Montecito, May 1, 1918, and sent in under Hopkins No. 15605[c1]. The guests emerged May 13, June 8 and 17, 1918.

MYRTOPSEN MIMOSAE, new species

Female.—Brown, thorax and abdomen nearly black. Head and thorax covered with white pubescence and from above wedge-shaped. Head granulate, from above transverse, broader than thorax, cheeks not enlarged behind eyes, occiput concave with oblique striae on

each side; from in front broadest above middle, malar space .55 eye without groove, antenna 13-segmented lengths as (scape) 13 (width 5.5) : 8 (5) : 13 (4) : 10 : 9 : 9 : 9 : 9 : 9 : 9 : 8.5 : 8 : 13 (6). Pronotum broad in middle and subtruncate. Mesoscutum broader than long, coarsely transversely rugose, parapsidal grooves percurrent, broader behind, no median, anterior and lateral lines not prominent. Disk of scutellum rugose, tapering toward apex which is slightly truncate, with two distinct smooth pits at base. Carinae on propodeum heavy, arcuate with a spur on outer side of each to spiracle, neck smooth. Mesopleura bare, polished. Hind tarsus about as long as tibia, its segments as 18 : 9 : 7 : 5 : 9 (with claw 11), claws weak, simple. Wing hyaline, pubescent, ciliate, veins brown, first abscissa of radius arcuate, half as long as second, radial cell closed, two and four-tenths times as long as broad, no areolet, cubitus directed toward and reaching half-way to lower end of basal. Abdomen as long as head and thorax, length to height to width as 86 : 60 : 45, almost truncate posteriorly, first tergite smooth, the big tergite on dorsal margin and the fourth on the posterior with lengths as 77 : 21, the fourth and posterior portion of the big one microscopically punctate, pubescent patches at base, ventral valves parallel with long hypopygium, ventral spine very short. Using width of head as a base the length of mesonotum ratio as 1.1, antenna 2.2, wing 3.0, ovipositor 3.4. Length, 1.9–2.4 mm. Average of 8 specimens, 2.27 mm.

Male.—Differs from female in having 14-segmented antennae, lengths of first five as 13 : 8 : 28 : 11 : 11—the third bent, swollen at apex, stouter than scape, flagellum tapering from third to tip. Abdomen shorter than head and thorax, truncate behind big tergite, lengths along dorsal and posterior curvature as 55 : 20 : 2 : 1 : 13, last coarsely punctate and pubescent, punctation of big tergite and following one as in female. Length, 2.1–2.45 mm. Average of 9 specimens, 2.26 mm.

Type.—Cat. No. 27227, U.S.N.M. Type female, allotype, 3 female and 3 male paratypes. Paratypes at Field Museum and Stanford.

Biology.—Living flies were cut out of galls on *Mimosa biuncifera* on August 10, 1918. The galls are abrupt stem swellings produced on one side of the twigs, globular or ellipsoidal in shape, measuring up to 20 mm. in diameter, covered with normal bark and consisting of parenchymatous tissue in which are many cells. The preserved galls become very hard but contain no true wood. The flies are thought to be guests but the maker of the gall is yet to be determined.

Habitat.—The type material is from the Huachuca Mountains, Ariz. The galls were collected July 10, 1918 at the mouth of Carr Canyon. The galls have been observed in the Chiricahua, Mule, Patagonia, Santa Rita and Santa Catalina Mountains.

DIASTROPHUS BASSETTII Beutenmueller

The gall of this species, produced at the crown of the trailing blackberry, has been collected at Rosslyn and East Falls Church, Va., and at Glen Echo (J. C. Bridwell), Md. The galls are full grown before end of August. Only guests were reared. Beutenmueller has taken galls at Tenafly, N. J., adults emerging June 20.

DIASTROPHUS FRAGARIAE Beutenmueller

This species producing a spindle-shaped gall on the petiole of wild strawberry leaf was described from males only. The female is here described.

Female.—Face with radiating ridges, malar space about .7 eye, interocular space .6 transfacial and area one and six-tenths times as broad as high, antenna 13-segmented, lengths as (scape) 13:7:13:13:12:12:11:11:10:9:9:9:16, last with transverse groove on one side, incompletely dividing it in proportion of 7:9. Pronotum with a median transversely elliptical truncation. Mesoscutum broader than long, highly polished, bare except for a few hairs scattered along parapsidal grooves which are deep and percurrent. Scutellum rugose, with two large pits at base. Propodeum with a network of fine ridges in place of usual carinae. Radial cell open, three and six-tenths times as long as broad, first abscissa of radius arcuate, second nearly as long as third abscissa of cubitus, no areolet, hind tarsus shorter than tibia, claws toothed. Legs about same color as antennae. Abdomen black, length to height to width as 87:65:58. Lengths of tergites along dorsal curvature as 2:39:19:10:0:0:12, hypopygium projecting back farther than the tergites, ventral spine very short. Using width of head as a base the length of mesonotum ratio is 1.3, antenna 2.48, wing 3.7, ovipositor 1.7.

Length, 2.3–2.7 mm. Average of five specimens, 2.5 mm.

Biology.—The galls are usually seen in June and July when if gathered they are too immature to rear. One may either mark the spot and come back in the fall or early spring for the galls or transplant the affected plants to home garden where it can be easily found. The writer transplanted to a city back yard two plants with galls found at Fort Sheridan, Ill., July 16, 1917. In the fall after the foliage had turned brown the galls were put in a breeding cage and left out-of-doors all winter. The flies emerged June 2, 1918. The writer has also seen galls at Glencoe and Kenilworth, Ill., and at East Falls Church, Va. The unpublished Walsh journal records finding the gall at Rock Island, Ill., on August 27, 1866. A specimen from Kingston, Rhode Island, was sent to Bureau of Entomology for determination. Brodie records the gall at Toronto in 1887, 1891, and in 1893 reared producers May 18–25.

DIASTROPHUS CUSCUTAEFORMIS Osten Sacken

Galls were collected at Evanston, Winnetka, Waukegan, and Willow Springs, Ill.; Batesburg (E. H. McGregor) and Fairfax, S. C.; Bedford County, Va.; Washington, D. C.; and New York City (Beutenmueller). About Chicago adults emerged June 6–11 and at Washington April 25. Brodie collected galls at Toronto, adults emerging May 29. He also reports the gall common on *Rubus villosus* at Aspdin and Port Sidney, Muskoka, where adults emerged May 30 to June 3.

DIASTROPHUS NEBULOSUS (Osten Sacken)

This gall on blackberry canes has been collected at Poplar Bluff, Mo. (adults emerged June 1–11); Chesterton, Ind.; Willoughby, Ohio; Farmingdale (Crosby) and New York City (Beutenmueller) (adults emerged April 20), N. Y.; College Park (Gahan), Md. (emerged April 24); Washington, D. C. (emerged May 1–30, 1912); Fairfax county (Cushman) (emerged May 27), Fredericksburg and Bluemont, Va.; Fairfax, S. C.; Billy's Island in Okefenokee Swamp (J. C. Bradley), Ga.

DIASTROPHUS NIGER Bassett

This spindle-shaped enlargement of the stem of *Potentilla canadensis* has been collected at Evanston (adults emerged April 15–May 1) and Fort Sheridan, Ill.; Poplar Bluff, Mo.; Hoxie, Ark.; (adults emerged at Evanston June 1–11); Onekama (T. Hatfield), Mich.; Ithaca, N. Y.; Washington, D. C. (flies emerged April 10–25).

DIASTROPHUS TURGIDUS Bassett

Galls collected at Glencoe, Ill.; in early May began to yield adults on May 20, 1907. From galls collected at Evanston flies emerged in 1909 on June 10. In 1912 they emerged May 1–15. Brodie collected galls on *Rubus strigosus* at Toronto and reared adults May 25–27, 1890, and in 1891 on May 21, 23, 24. In 1892 the new galls were full grown by July 17. He had galls sent to him from Grimsby from which flies emerged May 15–24. He reports the galls as common in 1892 around Port Sidney and at Whitechurch and common throughout Muskoka.

AYLAX GLECHOMAE (Linnaeus)

The writer has collected galls of this species at Evanston, Waukegan, Joliet, and Moline, Ill.; La Porte, Ind.; North East, Pa.; Medina and Ithaca, N. Y.; and Rosslyn and East Falls Church, Va. The green and succulent galls may be found developing in June,

turning brown in July, containing pupae at Evanston August 1 and 12 and adults on September 20. These adults remain in the galls over winter, emerging in the spring.

AYLAX GILLETTEI (Kieffer)

This species produces no visible gall but forms cells in the pith of stems of the compass plants, *Silphium laciniatum* and *terebinthinaceum*. From old dead stems collected at Evanston, Ill., in spring of 1912 flies of this and the following species emerged May 15, 30, June 11, 15, 17, 22, 24, 1912.

AYLAX RUFUS (Gillette)

Reared at Evanston, Ill., together with above species from stems of compass plant.

AYLAX HYPOCHOERIDIS (Kieffer)

Early in 1920 A. C. Burrill collected galls on the introduced European plant known locally as the false dandelion *(Hypochoeris radicata* Linnaeus) at Albany, Oreg., and sent some to the Bureau of Entomology and some to William Beutenmueller who reared adults in large numbers April 15 to May 15 and was the first to suspect that it was the work of a European cynipid introduced along with the plant. He sent galls and adults to the writer who has in turn submitted them to Prof. J. S. Tavares in Spain for direct comparison with European material. Doctor Tavares writes that "it is without doubt the European species. The gall is also the same." He sent specimens he had reared in Spain for the Museum collection. Prof. C. Houard, of Strassburg, to whom galls were submitted confirms this determination. This adds another to the small list of gall-making Cynipidae common to Europe and America—all on introduced European plants.

In the month of June 1922 the writer saw the galls growing at the following localities in Oregon: Cottage Grove, Walker, Creswell, Eugene, Corvallis, Albany, Jefferson, Salem, Brooks, Woodburn, Hubbard, Aurora, Barlow, Canby, New Era, Oregon City, Portland, Newberg, McMinnville, Sheridan, Willamina, Grande Ronde, Goble, and Troutdale. The plant without any galls on it was noted along the Columbia highway as far east as The Dalles, and as far south along Pacific highway as Grants Pass but not on road from Medford to Crater Lake, and not on road from Grants Pass to Holland. In Washington the plants are very common about Seattle and on road from Tacoma to Ashford but no galls were seen. Thus the cynipid has not kept up with the spread of the plant but wherever it does occur its galls are helping to check the plant by stunting the growth of the flower stalks.

In 1921 E. S. Gourlay sent a gall and adults which the writer determines as this species from Christchurch, New Zealand. Evidently the plant and its gall have been introduced there also in recent years as they have been on our own Pacific coast. Kirk's Students flora of New Zealand (1899) speaks of the plant as "naturalized throughout the colony."

AYLAX LACINIATUS (Gillette)

The writer collected these galls in the flower heads of *Silphium laciniatum* at Glen View, Ill., on September 3, 1914. They were kept in greenhouse during winter and adults emerged before April 27, much earlier than would have been the case out-of-doors.

AYLAX TARAXACI (Ashmead)

This species producing galls on petiole, midrib and flower stalk of the dandelion was described from Winona, Minn., and has been reported from Ontario by Cosens and at Hudson Falls, N. Y., by Felt. The gall has long been known in Europe. The writer has collected galls at Medina, N. Y., in Illinois at Evanston, Wilmette, and near Ottawa, and in Iowa at Davenport and Ames. The galls are most noticeable in June when they are green and fleshy but they should not be gathered for rearing until they have turned brown in the fall. Galls collected at Wilmette in September and kept out-of-doors during the winter gave flies in numbers on June 1, 1918. A visit to the same locality on June 7, 1919, showed both old galls and fresh ones about half-grown.

AULACIDEA HARRINGTONI (Ashmead)

Aulax harringtoni ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 146.
Aulax bicolor GILLETTE, Bull. Ill. St. Lab. Nat. Hist., vol. 3, 1891, p. 201.
Aulax mulgediicola ASHMEAD, Journ. Cincinnati Soc. Nat. Hist., vol. 17, 1895, p. 36.
Aulax cavicola ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 134.

Beutenmueller in 1910 wrote that the type of *harringtoni* was in the National Museum. The species was described from a single captured female sent to Ashmead by W. H. Harrington of Ottawa, Canada and through the kindness of H. L. Viereck we have recently learned that the Entomological Branch of the Department of Agriculture at Ottawa has a specimen labeled in Harrington's hand "Aulax Harringtoni Ashm. nov. sp." which must be the type. This specimen is an *Aulacidea* and Mr. Viereck has run it through a provisional key to the species and compared it with paratypes of *mulgediicola* and *podagrae* and with determined specimens of *tumida* and *ambrosiaecola* and "can see no difference between the paratypes of *mulgediicola* and the type of *harringtoni*. Beutenmueller has examined the types of *bicolor* Gillette and says they are the same as

mulgediicola. The type of *cavicola* Ashmead seems to the writer to be the same as *mulgediicola*. In certain positions the face shows a median ridge and in each case the hind basitarsus is equal to the remaining segments.

The writer reared flies from *Lactuca* stems at Evanston, Ill., which agree with types of *mulgediicola* Ashmead and which were determined by Beutenmueller as *bicolor* Gillette.

AULACIDEA NABALI (Brodie)

This species which forms galls at the base of the stem of *Prenanthes alba* was described from Toronto and has been reported from Quebec and Massachusetts. The writer has collected galls at Evanston, Ill., and reared the adults in numbers June 8–11, 1918. The American museum has a gall from Nyack, N. Y. (Zabriskie). After publishing the description of the species in 1892 Brodie collected more galls and reared adults June 10–18, 1892, and in 1893 they emerged June 1–19, 177 males and 151 females.

AULACIDEA PODAGRAE (Bassett)

This species has been reared at Wilmette, Ill., the flies emerging the first week in June. It makes rounded swellings at the nodes scattered along the stem of *Lactuca canadensis* and its cells also seem sometimes to be scattered in the pith without external evidence of a gall. Brodie collected the nodular gall at Toronto. Cells in the pith without external swelling were common at East Falls Church, Virginia, in fall of 1923.

AULACIDEA TUMIDA (Bassett)

The spindle-shaped leafy swellings of the stem of *Lactuca canadensis* collected at Wilmette, Ill., in March gave adults May 4–June 1, 1907. In 1908 the flies began to emerge May 20 and in 1913 they were emerging in May 30. In 1913 they emerged April 15–May 15. At Washington, D. C., flies began to emerge May 1. Brodie collected galls at Toronto, adults emerging June 8, 1892.

ANTISTROPHUS PISUM Walsh

This species is here recorded from the following unpublished localities: Greely, Nebr. (J. Q. Rood); Hebron, N. Dak.; Mandan, N. Dak. (H. F. Bain); Belford, S. Dak.; Garden City, Kans. (C. H. Popenoe); and Rexford, Kans. At the latter place the writer found the galls very numerous on roadside plants on October 1, but they were still green and too immature for rearing.

ANTISTROPHUS SILPHII Gillette

On June 23, 1915 the writer collected old galls of what he determines as this species on roadside plants of *Silphium perfoliatum* at Valley, Nebr. In 1917 galls from this locality were collected early in May and sent to Evanston, Ill., where adults emerged May 26, 31, and June 12. The National Museum has two galls from Omaha. The species was previously recorded only from Illinois. Beutenmueller erroneously used the name *leavenworthi* Bassett for this species instead of the older name *silphii* Gillette.

GONASPIS POTENTILLAE (Bassett)

Galls were seen on *Potentilla* at New York City (Sanford and Griffith); Bluemont, Va; Miller Ind.; and Glen Ellyn, Ravinia, and Kenilworth, Ill. In the Chicago area flies issued May 28, 1907: galls contained pupae on May 2 and adults began to emerge May 22, 1909; adults began to emerge before May 20 in 1912 and emerged May 15–18, 1913. P. R. Myers reared adults at Harrisburg, Pa., on May 17, 1908.

RHODITES BICOLOR (Harris)

This spiny rose gall has been taken at the following localities: Evanston, Glencoe, Ravinia, Fort Sheridan, and Waukegan, Ill.; Miller and Michigan City, Ind.; Medina, Ithaca and East Hampton (Schradieck), N. Y.; Alexandria, Va.; Landgraff (G. C. Ray), W. Va. In the Chicago area the new galls are full grown but still succulent the last of June, turning brown in July, after which they may be gathered for rearing. Galls kept in cage in greenhouse gave adults the next spring April 30, May 17, May 30. All emerge the first season. Brodie collected galls at Toronto and had galls sent to him from Calgary, Alberta.

RHODITES DICHLOCERUS (Harris)

The spiny form of this gall was common at Winnetka, Ravinia, and Waukegan, Ill., and was taken also at North East, Pa. Galls in Chicago area collected in early spring gave adults of both sexes May 27, June 7, 11, 21, 1909. In 1911 they emerged May 22 and 24. On May 24 some of the females were liberated on small wild rosebushes recently transplanted to greenhouse and having fresh shoots 5–6 inches high. On May 25 a female was seen ovipositing near the tip of one of these shoots. On June 5 a belt of grandular hairs at this point was the first evidence of gall formation and by June 18 the developing gall was 5 mm. in diameter. Adults issued from it in greenhouse the next spring before March 15. Brodie collected the gall at Toronto.

The smooth form of the gall was taken but rarely at Ravinia and New Lenox, Ill. and at Medina, N. Y. Mr. A. B. Gahan collected galls at College Park, Md. and adults began to emerge May 21, 1914.

RHODITES FUSIFORMANS Ashmead

Galls were collected at Evanston and Winnetka, Ill., where adults issued May 13–23, 1908, in first week of June in 1909, May 30–June 17, 1912; at West Cliff (the type locality) and Colorado Springs, Colo.; at Flagstaff, Ariz., where adults issued June 2 and 11. H. Y. Gouldman collected galls at Mandan, N. Dak. and Paul B. Sears at Lincoln, Nebr. on *Rosa pratincola.* Brodie collected galls on *Rosa blanda* at Toronto and reared adults June 18–20, 1890, and June 24–July 7, 1891.

RHODITES GRACILIS Ashmead

Galls of this species were collected at Evanston, Wilmette, and Winnetka, Ill., and at Kilbourn, Wis. From over-wintering galls collected early in May at Winnetka, adults emerged on May 15, 22, June 6 and 10. Another year living flies were found in breeding cage on June 2. Brodie collected galls on *Rosa blanda* at Toronto and reared adults June 23, 1888, July 12, 1892, June 12 to July 1, 1894.

RHODITES IGNOTUS Osten Sacken

The mealy rose gall was taken at Waukegan, Ill. (adults emerged in April); Miller and Dune Park (began to emerge April 15), Ind.; Webster Groves and Ironton, Mo., Troy, Ala.; East Falls Church, Va.; Washington, D. C.; College Park (Gahan), Md. (adults emerged April 24); and Shelter Island (Crosby), Queens County, N. Y.

RHODITES MULTISPINOSUS Gillette

Galls collected on a wild rose at Fort Sheridan, Ill. in April gave adults from April 27 to May 13, 1915. Galls taken at Wilmette on April 13, 1919, contained pupae and adults emerged May 10–18. Galls from Madison, Wis., gave flies May 5, 1919. Brodie collected galls on *Rosa blanda* at Toronto and reared adults June 21, 1888, May 5–31, 1890, April 19–25, 1893, and May 19 to June 2, 1904. He received galls also from Neepawa and Portage la Prairie, Manitoba; Prince Albert, Saskatchewan; and Calgary, Alberta.

Galls on *Rosa rugosa* collected at Minneapolis, Minn., in September, 1916, contained pupae April 28 and adults issued May 20–30, 1917. These flies seem to be the same as Gillette's type. A gall was collected on this cultivated rose at Evanston, Illinois and H. Y. Gouldman took some at Mandan, N. Dak. from which was reared *Orthopelma luteolator* (Gravenhorst).

RHODITES NODULOSUS Beutenmueller

Evanston, Ill., is one of the type localities for this species, the galls being collected on sweetbriar rose May 11, 1909, when they contained pupae. Adults emerged from May 25 until early in June. Galls collected in Wilmette April 13, 1919 contained pupae and adults emerged May 12 and 17. Similar galls on *Rosa rugosa* at Vicksburg, Mich., gave flies which seem to be this species.

RHODITES PUSTULATOIDES Beutenmueller

The two type flies of this species were reared May 24, 1913 from an unknown rose gall from Miller, Ind. The writer has reared flies which agree with the above types from galls collected at East Falls Church, Va., in July 1920, the flies emerging April 9, 1921. The galls were globular, thin-walled, armed with weak spines, smaller than those of *bicolor* and similar to those of *nebulosus*.

RHODITES RADICUM Osten Sacken

Large dark red galls were collected in summer of 1907 about the base of *Rosa carolina* growing in creek bottom 2 miles south of Medina, N. Y., adults emerging June 10, 1908. The galls were not underground but partially hidden by the debris that had become entangled about the base of the bushes at time of high water. More galls were collected from the same bushes August 29, 1908, adults emerging in out-of-door cage at Evanston, Ill., the next July. These flies agree with Osten Sacken paratypes.

RHODITES ROSAE (Linnaeus)

The mossy rose gall on the sweetbriar rose was collected at Evanston, Kenilworth, and Waukegan, Ill.; Adrian (O. Clark), Mich.; North East, Pa.; Medina, Albion and Ithaca, N. Y.; Chesapeake Beach (L. Haney), Md.; and East Falls Church, Va. About Chicago the adults issued April 27 to May 4, 1907, and the new galls were developing on the leaves by June 28. In 1909 adults began to emerge May 25.

The Brodie notes say that the gall is said to have been seen at Toronto in the fall of 1868 but he first noticed it in summer of 1872. Adults emerged there May 21, 1884, May 20, 1885, May 24, 1886. He received galls from Grimsby, Ontario, from which producers emerged May 13–16, 1892. "Old residents of Grimsby agree in saying that the gall first appeared there in the year 1889."

RHODITES ROSAEFOLII Cockerell

Galls were collected at Leadville, Colo.; Thistle, Utah; Flagstaff, Ariz. (adults emerged April 18 and 24); Waukegan (adults emerged May 11 and June 14), Ravinia and Evanston, Ill.; and Medina, N. Y.

Brodie collected galls on *Rosa blanda* at Toronto in August when the larvae appeared to be mature and reared adults the next spring in June.

RHODITES SEMIPICEUS (Harris)

Galls of this species (=*fulgens* Gillette) on the roots of wild rose were collected at Wilmette, Kenilworth, Winnetka, and Glencoe, Ill., and at Miller, Ind. Adults emerged May 29, 1912; May 1–21, 1913; May 15–June 10, 1915. Brodie collected galls on roots of *Rosa blanda* at Toronto and reared adults, 370 females and 4 males, May 18–29, 1892. The National Museum has flies from New Haven, Conn.; Hackensack, N. J. (emerged May 12, 1915); Flatbush (M. Kenny), N. Y. (emerged May 7); South Dakota (Baker); Canada (Baker); Ashland (T. A. Williams) and Raymond (P. B. Sears), Nebr.

Galls yielding similar flies were taken on *Rosa rugosa* at Evanston, Winnetka, Glencoe, and Lockport, Ill., and at Minneapolis, Minn. Winnetka galls collected in November and kept moist in laboratory began to yield flies January 27. In the field at the same locality flies had not yet begun to issue on May 12 when two more galls were collected, flies emerging on May 17, 1907. Evanston galls of the previous season were collected in May and flies emerged June 8–12, 1916.

RHODITES UTAHENSIS Bassett

The writer has taken large deeply-cleft root galls on rose at Thistle, Utah; Colorado Springs, Colo.; and at Winnetka and Glencoe, Ill., where adults emerged May 12–June 1, 1915, and in greenhouse April 2, 1916. Cornell has some fine galls from Logan Canyon, Utah. Brodie collected similar galls on *Rosa blanda* at Toronto and found the larvae pupating on April 17, the adults emerging May 19–June 5, 1892.

EXPLANATION OF PLATES

PLATE 1

FIG. 1—Galls of *Neuroterus escharensis* Weld. × 5.
2—Galls of *Neuroterus saltarius* Weld. Natural size.
3—Galls of *Diplolepis aggregata* Weld. Detached. Natural size.
4—Galls of *Diplolepis capillata* Weld. × 5.

PLATE 2

FIG. 5—Galls of *Diplolepis cava* Weld. Natural size.
6—Galls of *Diplolepis discalis* Weld. × 5.
7—Galls of *Diplolepis sessilis* Weld. Natural size.
8—Galls of *Diplolepis sulfurea* Weld. Natural size.
9—Gall of *Diplolepis unica* Weld and longitudinal sections. × 5.

PLATE 3

FIG. 10—Galls of *Plagiotrochus suberi* Weld. × 2.
11—Galls of *Cynips maculosa* Weld. × 2.
12—Galls of *Cynips plumbea* Weld. Natural size.
13—Galls of *Andricus biconicus* Weld. ×5.
14—Galls of *Andricus chrysobalani* Weld. × 5.

PLATE 4

FIG. 15—Galls of *Andricus deciduatus* Weld. × 5.
16—Galls of *Andricus fimbrialis* Weld. × 5.
17—Gall of *Andricus foliosus* Weld. Natural size.
18—Gall of *Andricus robustus* Weld. Natural size.
19—Gall of *Andricus rugatus* Weld. × 5.

PLATE 5

FIG. 20—Gall of *Andricus toumeyi* Weld. × 5. Leaves removed.
21—Gall of *Andricus tubalis* Weld. × 5.
22—Galls of *Andricus tubularius* Weld. Natural size.
23—Galls of *Callirhytis attigua* Weld. Natural size.

PLATE 6

FIG. 24—Galls of *Callirhytis gallaestriatae* Weld. × 5.
25—Galls of *Callirhytis mamillaformis* Weld. × 5.
26—Gall of *Amphibolips ellipsoidalis* Weld. × 5.
27—Galls of *Eumayria herberti* Weld. Natural size.

PLATE 7

FIG. 28—Gall of *Neuroterus sadlerensis* Weld, natural size; also base of male and female antenna and part of venation, greatly enlarged.
29—Gall of *Neuroterus fugiens* Weld; also an enlarged longitudinal section of gall.
30—Gall of *Diplolepis acraspiformis* Weld; also enlarged longitudinal section of gall.
31—Longitudinal section of gall of *Diplolepis amphora* Weld. Enlarged.
32.—Gall of *Diplolepis caepula* Weld; also longitudinal section. Both enlarged.
33—Gall of *Diplolepis discalis* Weld; also longitudinal section. Enlarged.
34—Gall of *Diplolepis discularis* Weld; also a longitudinal section. Enlarged.
35—Gall of *Diplolepis sessilis* Weld; also a longitudinal section greatly enlarged.
36—Gall of *Diplolepis sulfurea* Weld; also a longitudinal section greatly enlarged.

PLATE 8

FIG. 37—Galls of *Disholcaspis conalis Weld.* Natural size.

38—Galls of *Disholcaspis pedunculoides* Weld, slightly reduced.

39—Galls of *Trigonaspis cupella* Weld; also an enlarged view of gall and a longitudinal section of same.

40—Gall of *Xanthoteras teres* Weld; also longitudinal section enlarged.

41—Longitudinal section of gall of *Xanthoteras tubifaciens* Weld. Enlarged.

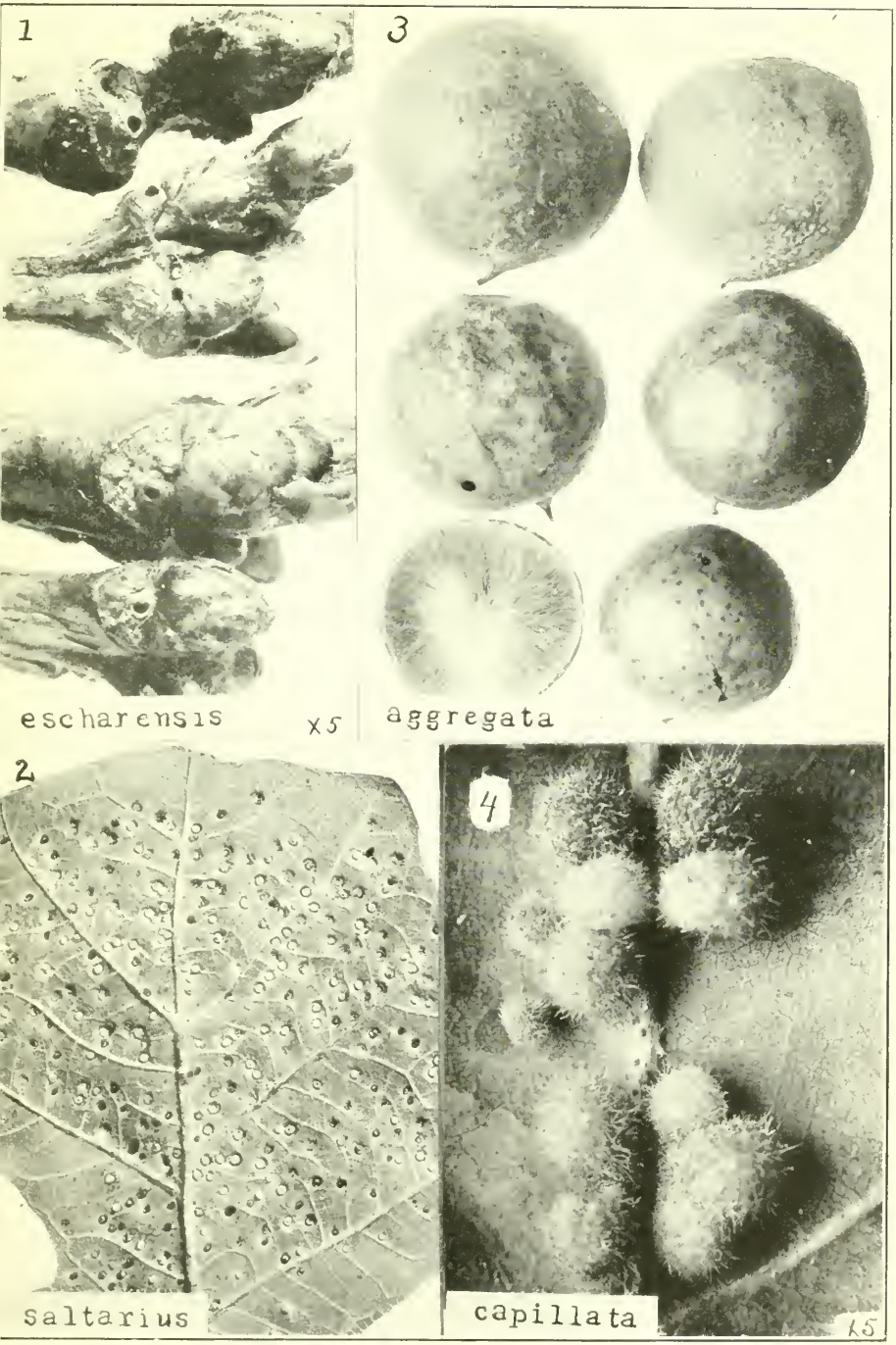
42—Gall of *Acraspis insolens* Weld; also a side view and longitudinal section, greatly enlarged.

43.—Galls of *Acraspis patelloides* Weld; also an enlarged longitudinal section.

44—Gall of *Cynips maculosa* Weld; also enlarged section showing internal structure.

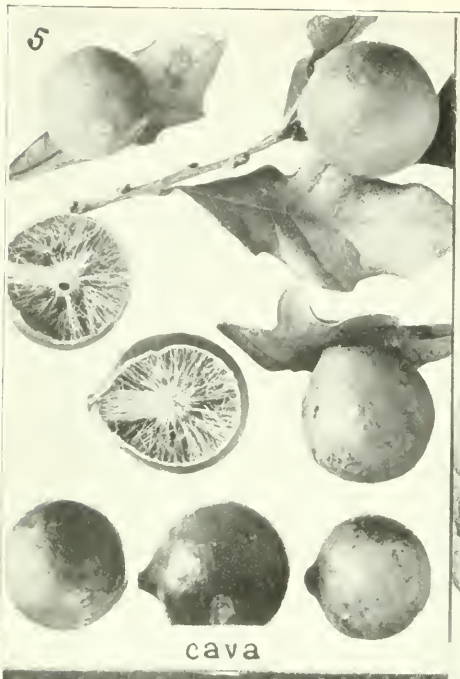
45—Galls of *Andricus albobalani* Weld, inside acorn. Enlarged.

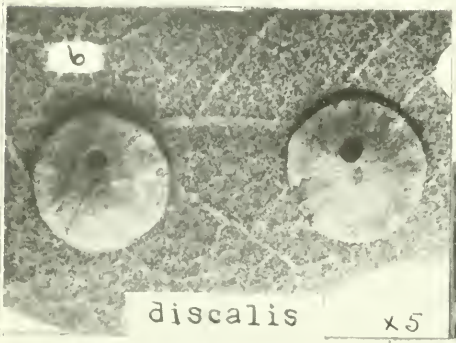
46—Dorsal view of gall of *Andricus stellaris* Weld; also longitudinal section. Both enlarged.

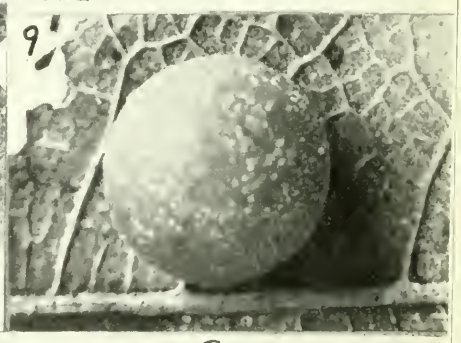


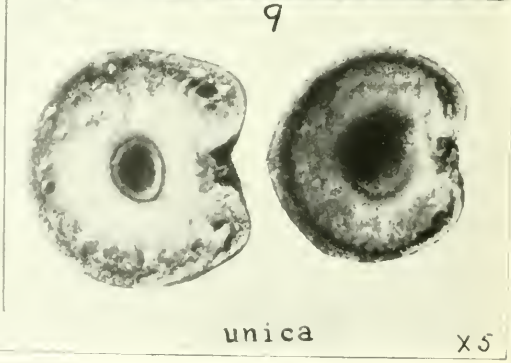
GALLFLIES OF THE FAMILY CYNIPIDAE

FOR EXPLANATION OF PLATE SEE PAGE 127



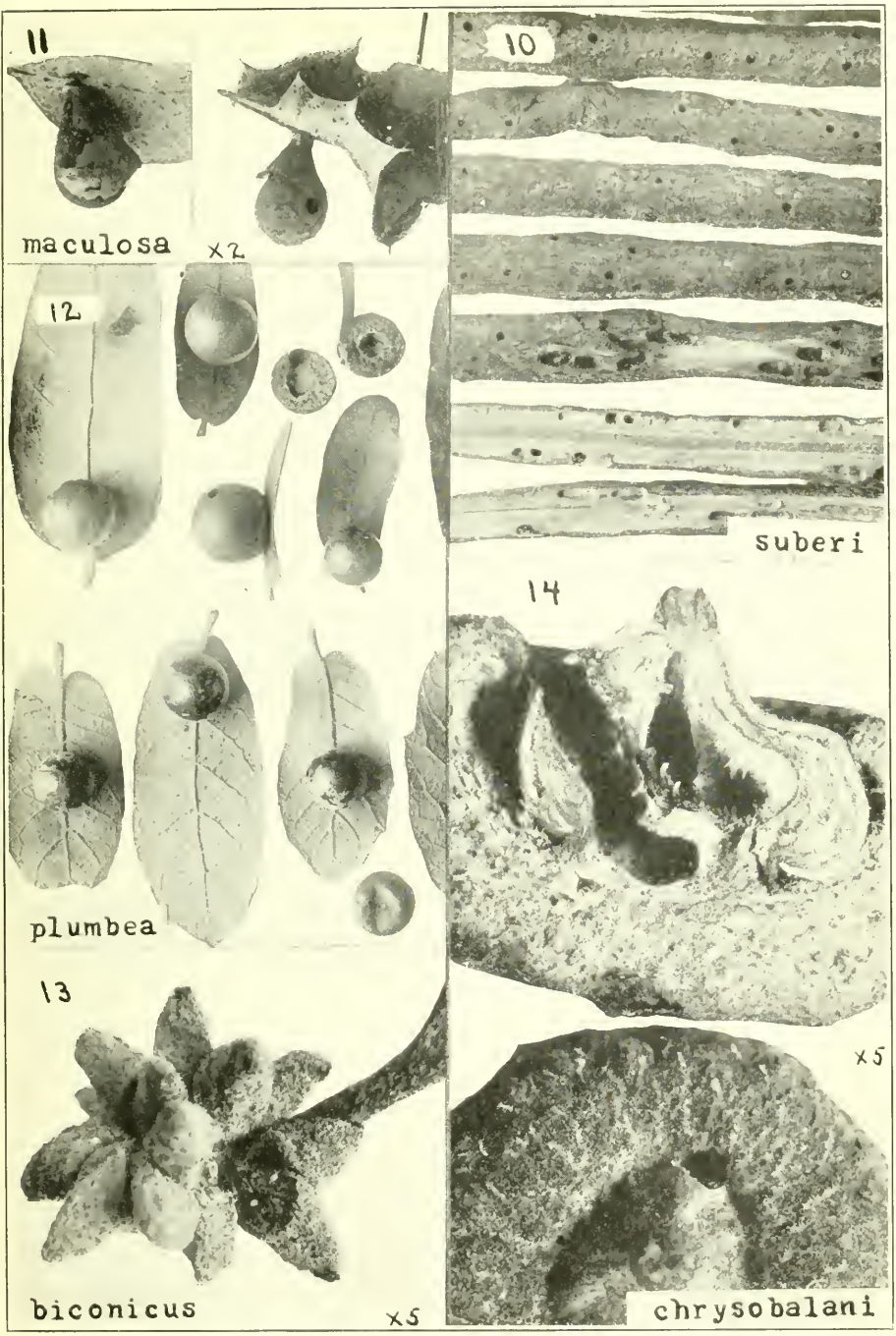






GALLFLIES OF THE FAMILY CYNIPIDAE

FOR EXPLANATION OF PLATE SEE PAGE 127



GALLFLIES OF THE FAMILY CYNIPIDAE

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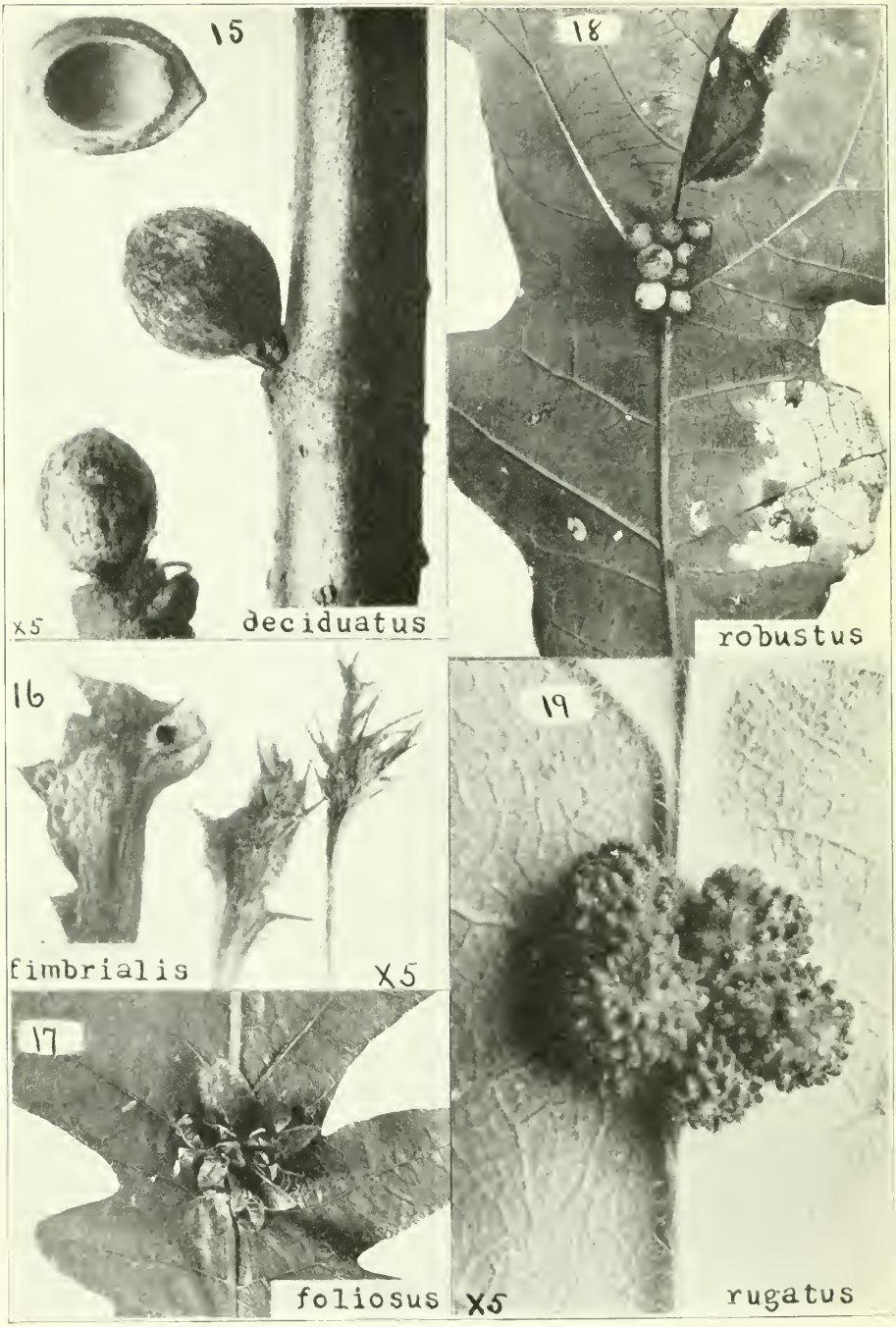
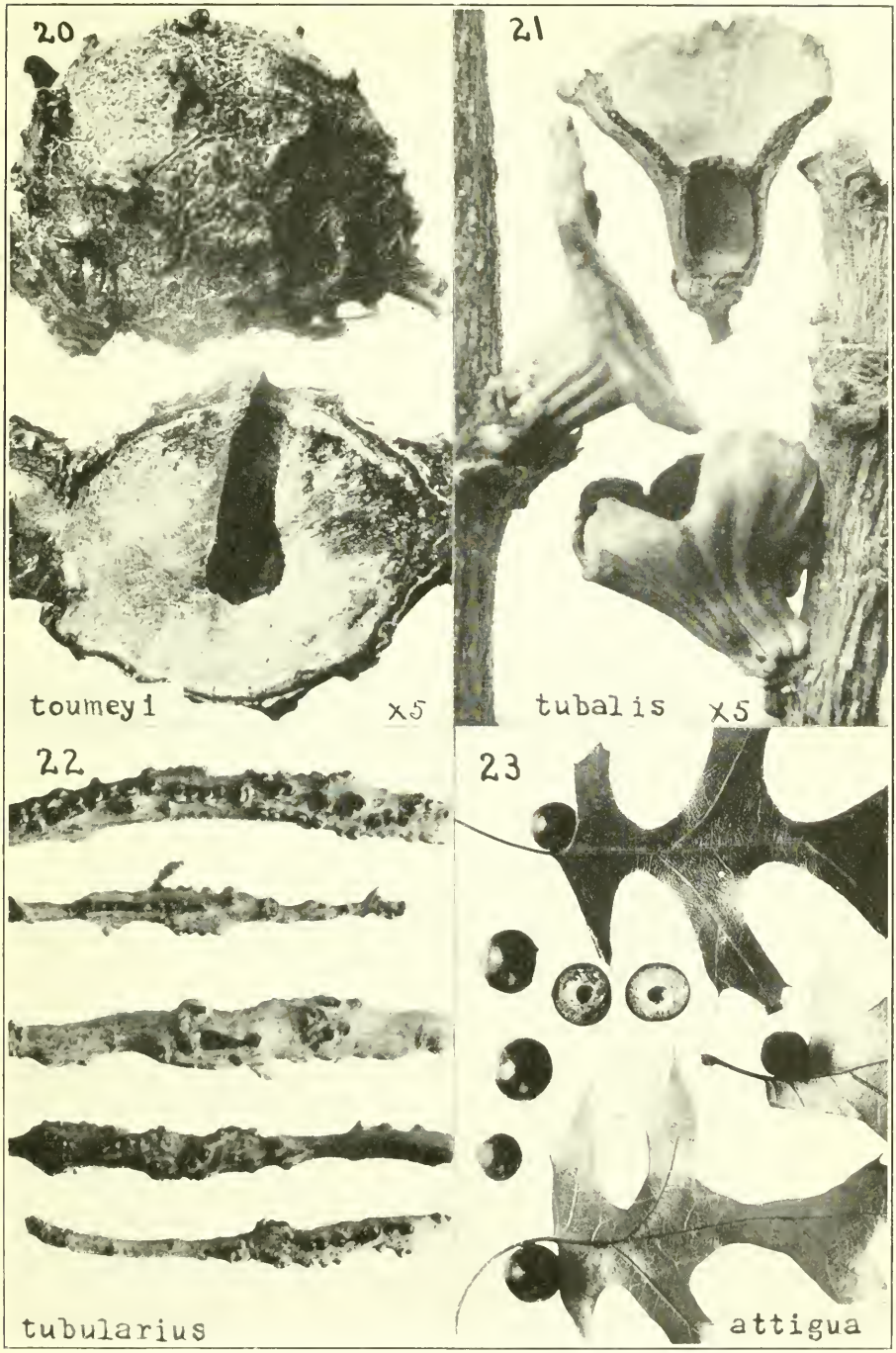


GALLFLIES OF THE FAMILY CYNIPIDAE

FOR EXPLANATION OF PLATE SEE PAGE 127



GALLFLIES OF THE FAMILY CYNIPIDAE

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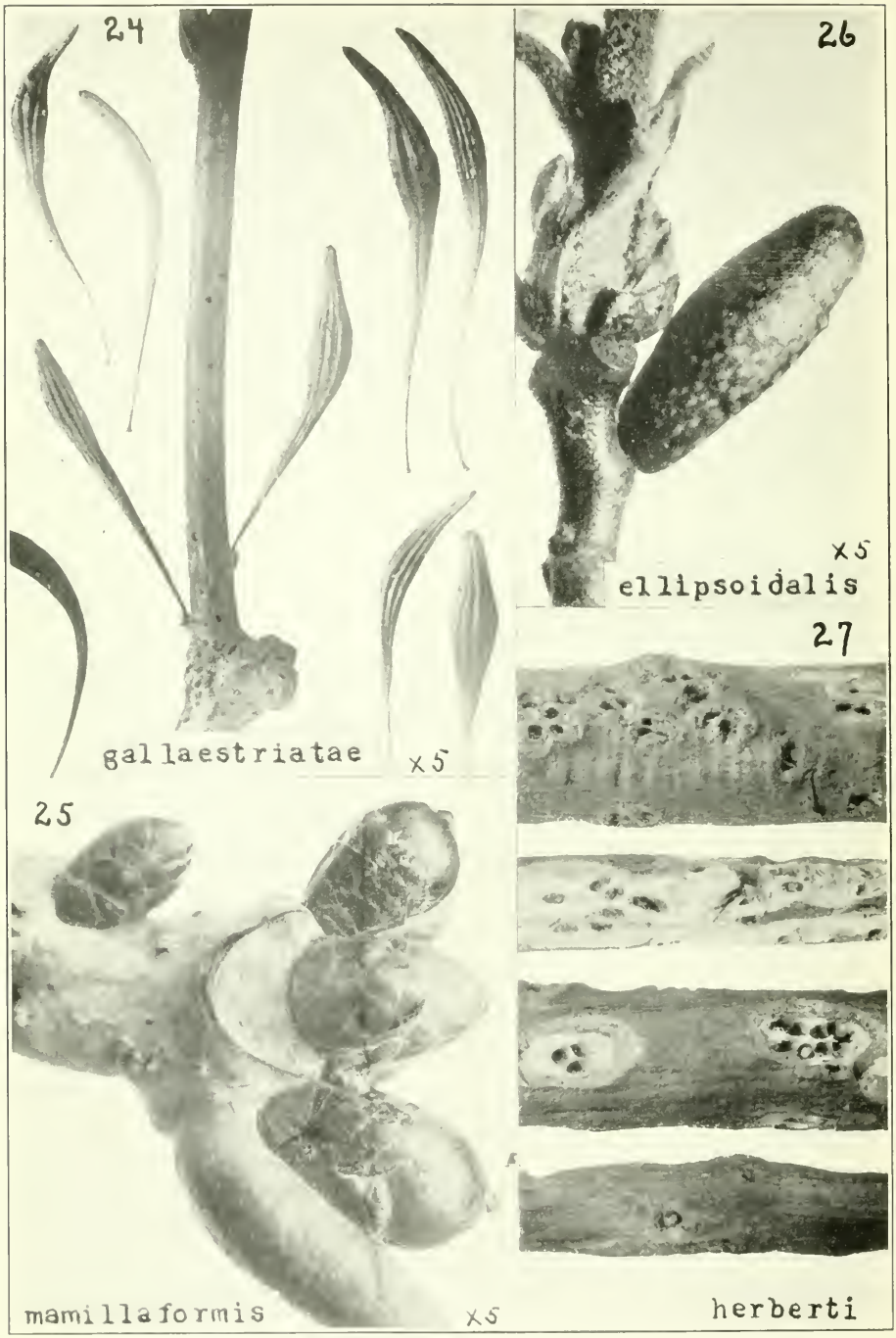
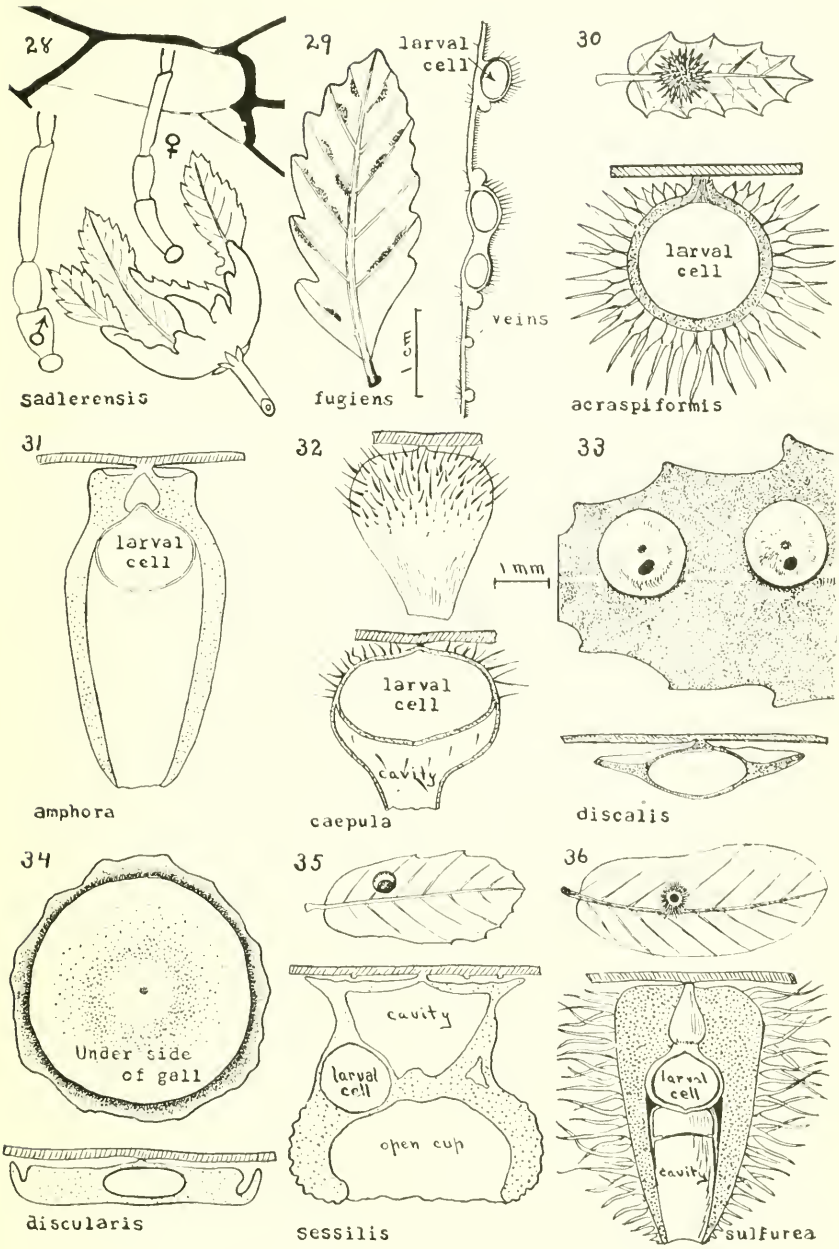


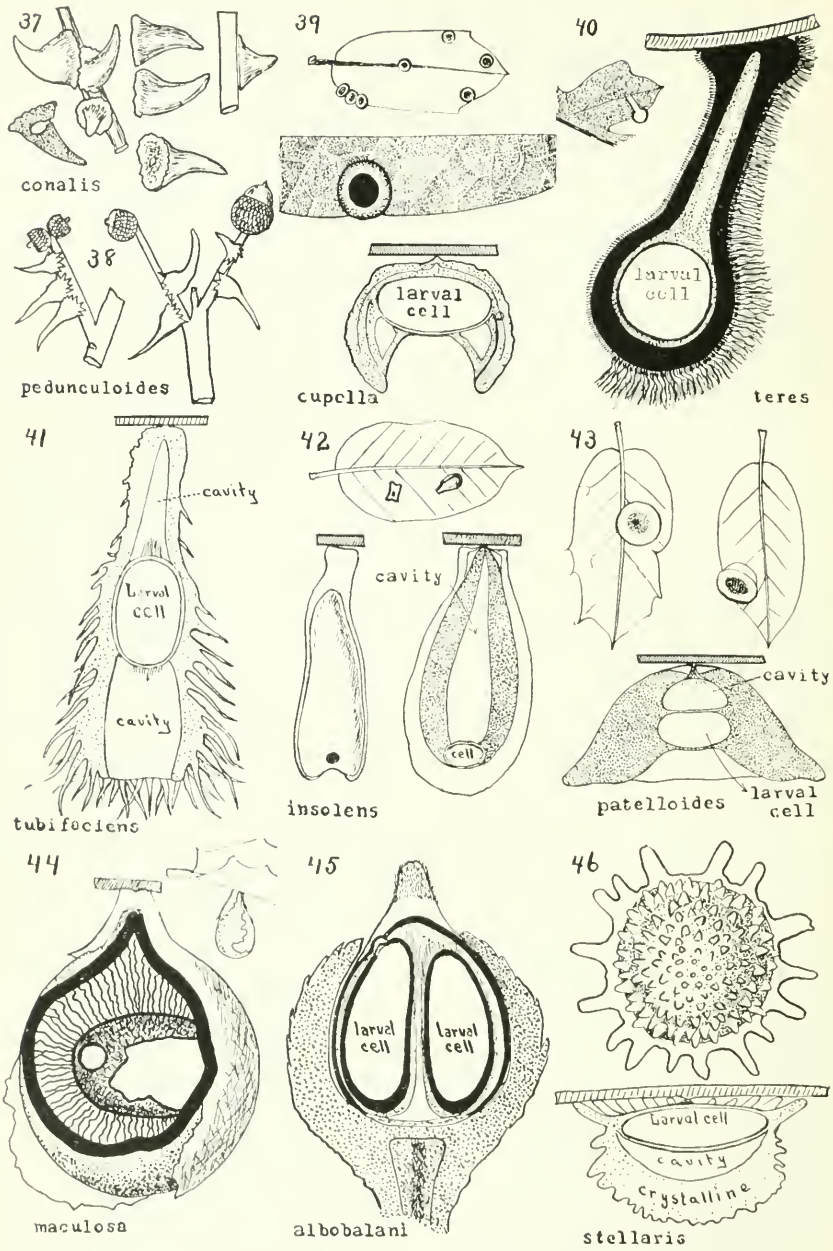
GALLFLIES OF THE FAMILY CYNIPIDAE

FOR EXPLANATION OF PLATE SEE PAGE 127



GALLFLIES OF THE FAMILY CYNIPIDAE

FOR EXPLANATION OF PLATE SEE PAGES 127 AND 128



GALLFLIES OF THE FAMILY CYNIPIDAE

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NEW FOSSIL FRESH-WATER MOLLUSKS FROM FLORIDA

By William B. Marshall,
Assistant Curator, Division of Mollusks, United States National Museum

Manly D. Barber, of Knoxville, Tennessee, while visiting West Palm Beach, Florida, recently sent to the United States National Museum a lot of fossil shells for identification. They were labeled "Fossils from marls, thrown from canals, West Palm Beach, Florida." The lot includes two species of *Lymnaea*, a species of very large *Planorbis*, and an unusually thick species of *Physa*. It was found that all four of the species were new. Three of them are described below. The *Physa*[1] has been described by William J. Clench, of the University of Michigan. All data obtainable indicate that they belong to the Pliocene. The *Planorbis* is very closely related to *P. conanti* Dall, of the Caloosahatchie Beds of the Pliocene of central Florida. A test with acid shows the marl to be highly calcareous.

LYMNAEA (PSEUDOSUCCINEA) BARBERI, new species

Plate 1, fig. 5

Shell fragile, imperforate slender, very elongate, whorls rapidly descending, very slightly rounded, front aspect of body whorl appearing to be compressed; sutures very oblique, well impressed, subcrenulate. Sculpture consisting of many fine, axial growth lines and several indistinct impressed spiral lines; aperture one-half the length of the shell, ovate, its upper angle bent down and coming within two millimeters of the columella where it enters the aperture; outer lip thin, parallel with the axis; basal lip widely rounded, columellar lip very oblique.

The type, Cat. No. 353155, U.S.N.M., measures: height, 20 mm.; diameter, 8 mm.; length of aperture, 10 mm. Cat. No. 353156 includes eight paratypes.

The species is named in honor of Manly D. Barber, who has long been a liberal contributor to the Museum's collections.

The only species to which this seems to bear any relation is *Lymnaea* (*Pseudosuccinea*) *columella* Say.

[1] Occ. Papers Mus. Zool. Univ. of Michigan, No. 164, pp. 1–3, pl. 1, Aug. 3, 1925.

LYMNAEA (PSEUDOSUCCINEA) APERTA, new species

Plate 1, fig. 4

Shell fragile, imperforate, much stouter and less elongate than *barberi;* whorls rapidly descending, suture moderately oblique, well impressed, subcrenulate; sculpture consisting of fine axial lines of growth, and hints of spiral malleation. Aperture less than half the length of the shell; about half as wide as long; its outer lip thin, oblique to the axis of the shell, somewhat rounded, its basal portion well rounded; columellar lip thin, less oblique than in *barberi;* parietal wall with a thin glaze.

The type, Cat. No. 353154 U.S.N.M. measures: Height, 17.5 mm.; diameter, 9 mm.; length of aperture, 11 mm.

The name *aperta* was suggested by the flaring aperture. This shell shows a distinct relationship to *columella* Say and also to the new species described above as *barberi.* It may be an ancestor of *columella.*

PLANORBIS (PLANORBINA) PREGLABRATUS, new species

Plate 1, figs. 1, 2, 3

Shell large, much compressed vertically, sunken on both spire and base. (In this description the shell will be treated as dextral, though that is subject to doubt.) Whorls seven, a large portion of each exposed in both the spire and the umbilicus; body whorl obtusely angular above and below, its middle portion but slightly convex, and the upper diameter much larger than the lower, making the whorl generally oblique. In the type and some of the paratypes the whorls in the spire and in the umbilicus overlap each other irregularly, instead of each whorl being neatly affixed to the outer surface of the preceding whorl. In other paratypes the growth is regular. Sutures deeply impressed, giving the whorls a semisolute appearance. Sculpture consisting of many fine, flexuous, retractive growth lines, and nearly equally spaced riblets; at intervals the striae across the body whorl are more deeply impressed, indicating a short period of rest in growth. About halfway round the body whorl a transverse thickening shows the point at which there was a prolonged rest period. Aperture very oblique, lip simple, a moderately thick callus on the parietal wall. Evidently, when living the shell was glossy, especially on its lower surface.

The type, Cat. No. 353152 U.S.N.M. measures: Height, 10.5 mm.; diameter, 29.5 mm. Cat. No. 353153 includes 13 paratypes.

The fact that this species is related to the recent shell *P. glabratus* and preceded it in time is indicated by the name *preglabratus.* It is also closely related to *P. conanti* Dall of the Caloosahatchie beds

(Pliocene) of central Florida, but is more compressed vertically. It differs from *P. glabratus* in having more whorls, in greater size and in the semisolute appearance of the whorls in the spire and umbilicus.

NOTES ON SEVERAL SPECIES OF PLANORBIS OF FLORIDA AND VICINITY

The close relationship of *preglabratus* with the recent shell *glabratus* naturally called attention to the latter species, and, while studying the history of the latter, the following notes were made concerning it and other species of Florida and vicinity. While visiting the Academy of Natural Sciences of Philadelphia recently its collection of *Planorbis* was examined and the subject was discussed with Dr. H. A. Pilsbry and Mr. Vanatta, who were able to add additional information. Doctor Pilsbry in his study of the Mollusca of the State of New York, to be published in the near future, will go deeply into the history of some of the species of *Planorbis*, among them *P. trivolvis* Say, and *P. lentus* Say, *P. bellus* Lea, and *P. pseudotrivolvis* Baker. Hence a discussion of these forms is unnecessary here, although *P. trivolvis* is found in Florida and the others found elsewhere are not distinctly separable from it.

Pilsbry [2] has said: "*Planorbis glabratus* Say has not been found in Mexico; nor does it range in the United States, outside of the peninsula of Florida. The *P. glabratus* of author's is not the true *glabratus* of Say." According to Bryant Walker,[3] "Haldeman's and Binney's figures do not represent this species, which is entirely distinct from *trivolvis*. It is not uncommon in Florida and in the United States does not range outside of that State. * * * The true *glabratus* belongs to the section *Planorbina* and not to *Pierosoma*."

The specimen figured by Binney [4] in Land and fresh-water shells of North America, part 2, is in the National Museum (Cat No. 29219) with the locality doubtfully given as South Carolina. Specimens catalogued under No. 8500 by Binney in the above-mentioned work are still here under that number and come from St. Simon's Island, Georgia. None of these specimens agrees with Say's description of *P. glabratus*, nor do eleven specimens (Cat. No. 120984), nor six specimens (Cat. No. 28212), both lots from St. Simon's Island. Pilsbry and Walker are right in saying that the *P. glabratus* of authors is not the *P. glabratus* of Say.

The large, flattish, glossy shell now generally accepted as *P. glabratus* Say, is the only species that fits Say's description.

[2] Land and fresh water shells collected in Yucatan and Mexico, Proc. Acad. Nat. Sci., Phila., p. 321, 1891.

[3] Synopsis of the classification of the Fresh-water Mollusca of North America, North of Mexico, and a catalogue of the more recently described species with notes, Univ. of Michigan, Mus. Zool. Miscell. Publ., No. 6, p. 99, 1918.

[4] Smiths. Misc. Coll., No. 143, p. 106, fig. 179, 1867

especially in regard to "the total absence of a carina, and in having a more smooth and polished surface, as well as a declining and more oblique aperture than *P. trivolvis*." Whether one would say that *P. glabratus* has "a more profound and much more regularly concave umbilicus than *P. trivolvis*"[5] is doubtful.

The type of *P. glabratus* has not been found, and hence the description is our only guide for the species. Apparently Say's citation of "near Charleston, S. C.," was unfortunate, and probably he was dealing with a Florida specimen. At least no other specimens of *P. glabratus* have been recorded from the vicinity of Charleston. All things considered it seems best to accept, for the present at least, the flat, glossy shell of Florida interpreted by Pilsbry and Walker as *P. glabratus* Say, as being the species described by Say under that name. In the Academy of Natural Science of Philadelphia the specimen catalogued under 21379 is labelled in Say's handwriting "*P. glabratus* Say, S. Carolina." On the exhibition label (but not in Say's writing) the specimen is said to be a cotype, but the specific name *P. glabratus* has been crossed off. It seems to be a small but typical *trivolvis*. It seems likely that Say's label has been shifted from the specimen to which it originally applied.

The shell figured by Binney as *P. glabratus* has been identified by Pilsbry as *P. tumidus* Pfeiffer. As a rule this species is more compressed than is usual with *P. trivolvis* and this seems to have led Binney and others to believe that it is the *P. glabratus* described by Say.

P. tumidus Pfeiffer was figured by Binney as *P. glabratus* and belongs in the section *Pierosoma* with *P. trivolvis* Say and *P. duryi* Wetherby, while the glossy, recent shell now accepted as *P. glabratus* Say, and the Pliocene fossil species, *P. conanti* Dall, *P. disstoni* Dall, and *P. preglabratus* Marshall belong in the section *Planorbina*. *P. glabratus* and the three fossil forms just mentioned show a very near relationship to recent West Indian and northern South American forms such as *P. olivaceus* Spix and *P. guadalupensis* Sowerby.

EXPLANATION OF THE PLATE

(All figures multiplied by 1½ diameters)

FIG. 1. *Planorbis* (*Planorbina*) *preglabratus*, new species. Spire.
2. *Planorbis* (*Planorbina*) *preglabratus*, new species. Front.
3. *Planorbis* (*Planorbina*) *preglabratus*, new species. Umbilicus.
4. *Lymnaea* (*Pseudosuccinea*) *aperta*, new species.
5. *Lymnaea* (*Pseudosuccinea*) *barberi*, new species.

[5] When referring to "umbilicus," "base," and "spire" it must be remembered that Say described these species as sinistral.

1

4

2

5

3

FOSSIL FRESH-WATER SHELLS FROM FLORIDA

FOR EXPLANATION OF PLATE SEE PAGE 4

A CLASSIFICATION OF THE TOOTHLIKE FOSSILS, CONODONTS, WITH DESCRIPTIONS OF AMERICAN DEVONIAN AND MISSISSIPPIAN SPECIES

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A discussion of the systematic position of the conodonts formed the basis of the senior author's first paper published in 1878 [1]. At various times since that date, and during the past 20 years in association with the junior author, he has made quite extensive collections and studies of these difficult toothlike organisms. In his first paper, the senior author accepted somewhat reluctantly the prevailing opinion that the conodonts, like the more unquestionable annelid jaws, were the hooklets of species of annelids. In the subsequent comparison the true conodonts were early discriminated from the annelid jaws by him but until the present time no opportunity has been afforded to prepare and publish the results of these studies. The main intention of the present publication is to make these conodonts more available for detailed stratigraphic work by introducing a comprehensive classification. That this classification may be to some extent artificial is recognized. However, after extending our studies to such recent fishes as the Myxines and small selachians in which similar teeth and dermal plates occur, we feel certain the prevalent opinion that many kinds of these teeth may occur in the same mouth, or plates in the same dermal armor, is not warranted by the facts. Except that there are right and left pairs belonging in the case of teeth, to the right and left sides of the upper and lower jaw, the minute teeth wherever located in the mouth of the supposed living relatives of the conodonts, are essentially alike and thus each kind is characteristic of some particular genus and species. The dermal ossicles or plates are similarly divisible into right and left pairs but aside from this difference in addition to the easily

[1] Journal Cincinnati Society Natural History, vol. 1, 1878, pp. 87–91.

No. 2613.—Proceedings U. S. National Museum, Vol. 68, Art. 12.
60728—26——1

recognizable changes due to age, the many thousands covering the skin of a single fish are practically alike. So far then as we can learn from living fishes, the statement made on various occasions that no two of these teeth or dermal plates are exactly alike is utterly groundless. Moreover it is emphatically negatived by certain of our collections that contain thousands of examples absolutely indistinguishable in structural details except that one set is curved to adapt it to the right side and another the left side precisely as we found them in the supposedly related recent fishes.

The systematic position of the conodonts has been discussed and reviewed by several authors. A history of this discussion as well as a bibliographic index, including illustrations of the described species, forms a part of a paper by Grace B. Holmes now in course of publication. As indicated above, we believe the conodonts to be the teeth of primitive fishes and not necessarily all of the same group. For example as shown on plate 11, illustrating the teeth and dermal plates of certain recent fishes, *Distacodus* and its allies seem to be related to the Myxines while the more complicated Prioniodidae and Prioniodinidae show resemblance to the Selachians. The plates described under *Polygnathus* and related genera certainly exhibit much resemblance to the dermal plates of recent sharks and should perhaps not be classified with the toothlike, true conodonts. However as no true conodonts are known in Post Paleozoic strata it is possible they belong to an extinct group of fishes.

In our descriptions, we have considered the typical conodonts as composed of a basal portion or bar, upon which are arranged one or more denticles. One of the denticles may be more developed than the rest in which case it is termed the main cusp. For convenience in comparison, the illustrations have been arranged so that the bar is in a horizontal position. We have further considered that the downwardly bent portion of the bar when this is present, represents the anterior end upon the assumption that this end marked the attachment in the jaw.

Our generic studies have been based upon large collections of Devonian and Mississippian conodonts from many States, particularly from New York, Kentucky, Tennessee, Virginia, Alabama, Arkansas, and Ohio. All of these collections have been studied sufficiently to give a general idea of their contents, the purpose of this preliminary study being to determine whether any of the species from beds supposed to be of Mississippian age, contain anything exactly corresponding to those from known Devonian beds. We have failed to find a single instance of forms structurally identical in these two periods so that the conodonts have contributed most

conclusive paleontologic data concerning the age relation of the various Devonian and Mississippian black shale formations. In other words, none of the Genesee and Portage conodonts from New York localities could be accurately identified in the equally large conodont faunas from the Ohio black shale in Ohio, the major upper part of the New Albany black shale in Kentucky, or in the Chattanooga shales in East and Central Tennessee and Alabama. On the other hand many of the New York Devonian species of conodonts were satisfactorily recognized in unquestioned Devonian black shales that underlie 400 to 500 feet of Chattanooga shales in southwestern Virginia. Some of the same and other New York species are represented also in the locally developed basal parts of the New Albany shale of Kentucky in which they are associated with such other typical Devonian fossils as *Schizobolus truncata* (Hall). In so far then as the evidence of the conodonts is concerned, the post-Devonian age of the Chattanooga and Ohio shales. as long advocated by the senior author, seems conclusively established.

Two faunas, one of Upper Devonian age and the other from the basal Mississippian rocks, were selected for description at the present time; first, on account of the abundance and excellent preservation of the specimens; second, because the many species in these faunas gave us the opportunity to test the validity of our new genera; and, lastly, the two horizons represented made it possible to determine the value of the conodonts as index fossils. The Devonian fauna was obtained in the black Rhinestreet shale of the Portage group at Shaleton, Erie County, N. Y., a small station on the Buffalo and Lake Erie traction line about 14 miles southwest of Buffalo. Here, according to Mr. Raymond R. Hibbard, an enthusiastic paleontologist of Buffalo, who collected the specimens and generously presented the United States National Museum with ample material for study, the Rhinestreet shale is about 12 feet thick and almost barren of fossils except in the basal 10 inches, where the conodonts abound. Mr. Hibbard's efforts in promoting the study of the conodonts are to be commended, and we have had pleasure in naming the fine new genus *Hibbardella* in his honor. The second fauna was collected by the writers some years ago at Mount Pleasant, Tenn., in the Hardin sandstone, a thin more or less phosphatic basal sandstone forming the introductory member of the Mississippian-Chattanooga black shale in central Tennessee.

As noted above, the conodonts have not been employed in detailed correlation to the extent that they deserve because of erroneous impressions as to their variability and long range. We believe that if carefully prepared and discriminated, they will be found as

valuable in stratigraphic work as any group of organisms and because of their minute size they will be as useful in subsurface investigations as the foraminifera, bryozoa, and ostracoda.

METHODS OF STUDY

Perhaps in no other group of fossils is delicate preparatory work more necessary than here. In the black shales, in which most conodonts occur, this preparation is easily carried out, requiring only a steady hand and careful manipulation of tools. It is especially essential that the ends of the teeth or plates be carefully uncovered, for broken specimens or those more or less obscured by matrix can not be classified accurately, because fragmentary or exposed parts are often quite alike in otherwise dissimilar species and genera. Thus the main cusp of *Prioniodus*, *Bryantodus*, *Hibbardella*, and several other genera might readily be mistaken for the simple forms of *Drepanodus*. Several genera have been founded by earlier writers upon fragments of the denticulated bar and it will be imposible to place these with any degree of finality until entire specimens from the same locality and horizon have been studied.

Conodonts often occur in great numbers in basal sandstones or conglomerates where naturally they are more liable to be broken. Here, however, careful work will bring out many complete examples as is shown by our present studies upon the Hardin sandstone, the basal division of the Mississippian in central Tennessee. Free specimens are not always satisfactorily determined because they are more frequently imperfect. Such specimens are most valuable when during the course of preparation they can be freed from the matrix. However, even imperfect, free specimens can be accurately classified when complete examples of the teeth have previously been studied and illustrated.

After their preparation, the further study of the conodonts is much facilitated by whitening them with ammonium chloride and photographing them at a uniform magnification. By this method the individual specimens are thus made much more available for comparisons. The method of whitening the specimens has been described by the authors before, but for the sake of completeness we again insert a diagram of the apparatus and a few remarks as to the process.

By blowing through the mouthpiece *M*, the fumes of hydrochloric acid (HCl) and ammonium hydrate (NH_4OH) will unite at the outlets of the tubes O, and form a white sublimate of ammonium chloride upon any object held at this point. This sublimate can be deposited in such a uniform thin film, varying in color according to its thickness from a light blue to an ivory white, that all the details

of the surface are reproduced perfectly and can be viewed under the microscope without exhibiting any crystalline structure of the ammonium chloride. The white sublimate can be removed by simply blowing the breath upon the object so coated. The hydrochloric acid and ammonia used should be of great strength to secure the best results. Small quantities only should be employed so that the bottle

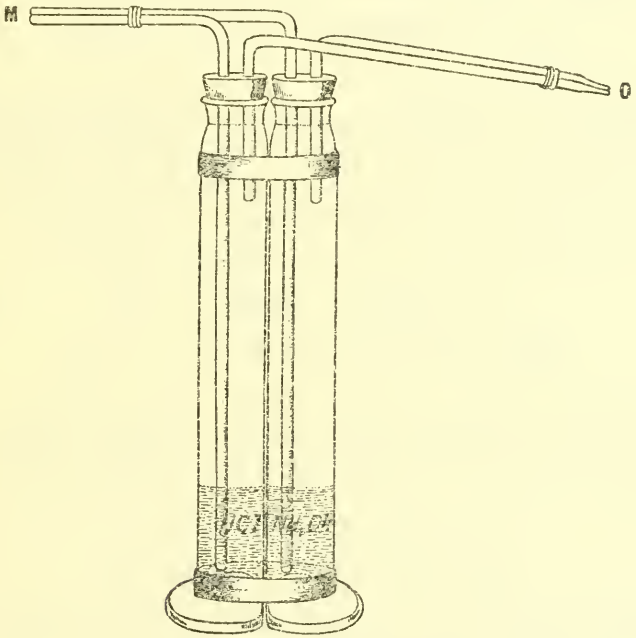

FIG. 1.—APPARATUS FOR PREPARATION OF AMMONIUM CHLORIDE SUBLIMATE

can be emptied and dried frequently, as the reagents not only absorb moisture but lose their strength in a day of use.

CLASSIFICATION

Our classification of the conodonts is summarized in the following table. Descriptions of the new families and new genera with text figures illustrating their characteristics are contained in the following systematic descriptions.

Class PISCES

TYPICAL CONODONTS (teeth of primitive fishes)

Family DISTACODIDAE, new family

Distacodus Hinde, 1879 (*Machairodus* Pander, 1856, preoccupied; *Machairodia* Smith, 1907); *Acodus* Pander, 1856; *Acontiodus* Pander,

1856; *Drepanodus* Pander, 1856; *Scolopodus* Pander, 1856; *Oistodus* Pander, 1856; *Paltodus* Pander, 1856.

Family PRIONIODIDAE, new family

Prioniodus Pander, 1856; *Subprioniodus* Smith, 1907; *Cordylodus* Pander, 1856; *Belodus* Pander, 1856; *Ligonodina*, new genus.

Family PRIONIODINIDAE, new family

Cornuramia Smith, 1907; *Hindeodella*, new genus; *Pachysomia* Smith, 1907; *Lonchodina*, new genus; *Prioniodina*, new genus; *Prioniodella*, new genus; *Bryantodus*, new genus; *Euprioniodina*, new genus; *Hibbardella*, new genus; *Lonchodus* Pander, 1856; *Valentia* Smith, 1907; *Prionognathus* Pander, 1856; *Palmatodella*, new genus; *Diplododella*, new genus; *Synprioniodina*, new genus.

FISH PLATES (dermal plates)

Family POLYGNATHIDAE, new family

Polygnathus (Hinde) Bryant, 1921; *Ancyrodella*, new genus; *Palmatolepis*, new genus; *Panderodella*, new genus; *Polygnathellus*, new genus, *Gnathodus* Pander, 1856; *?Ctenognathus* Pander, 1856.

SYSTEMATIC DESCRIPTIONS

DISTACODIDAE, new family

Conodonts consisting of a single, more or less oval tooth or main cusp with a small undenticulated basal expansion.

Distacodus Hinde, 1879 (*Machairodus* Pander, 1856, preoccupied, *Machairodia* Smith, 1907) *Acodus* Pander, 1856, *Acontiodus* Pander, 1856, *Drepanodus* Pander, 1856, *Scolopodus* Pander, 1856, *Oistodus* Pander, 1856, and *Paltodus* Pander, 1856 are referred to this family which comprises the simplest forms of conodonts. The differences between these genera as defined by Pander, are based upon the general shape and curvature of the tooth and particularly upon its cross section. These differences are shown in our text figure but without specimens of these various types of structure we will not attempt to give generic diagnosis.

Genus DISTACODUS Hinde, 1879

DISTACODUS RECTUS, new species

Plate 9, fig. 22

A simple, rather straight, elongate tooth, slightly flaring at base, with an obtusely rounded ridge on the inner and outer sides and a more sharply keeled one on the concave posterior side or edge.

Occurrence.—Mississippian (Hardin sandstone basal member of the Chattanooga shale); Mount Pleasant, Tenn.

Holotype.—Cat. No. 10982, U.S.N.M.

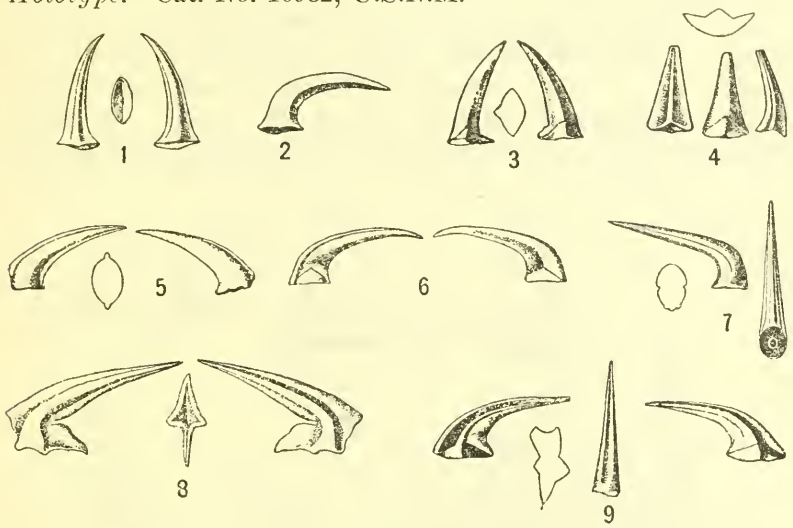

FIG. 2.—DISTACODIDAE, NEW FAMILY

1. 2. Genus *Distacodus* Hinde, 1879 (*Machairodus* Pander, 1856. Preoccupied, *Machairodia* Smith, 1907). (1) Lateral and basal views of *Distacodus* (*Machairodus*) *incurvus* Pander, 1856, selected by S. A. Miller as genotype. (2) Lateral view of *Distacodus* (*Machairodus*) *rhomboideus* Pander, 1856. Both from Lower Ordovician of Baltic Provinces.

3. Genus *Acodus* Pander, 1856. Opposite sides of tooth of genotype (first species) *Acodus erectus* Pander, 1856, and a transverse section of *Acodus acutus* Pander, 1856. Lower Ordovician of Baltic Provinces.

4. Genus *Acontiodus* Pander, 1856. Three views and transverse section of the genotype (first species) *Acontiodus latus* Pander, 1856. Lower Ordovician of Baltic Provinces.

5, 6. Genus *Drepanodus* Pander, 1856. (5) Opposite sides of tooth of *Drepanodus inflexus* Pander, 1856, and a transverse section of *Drepanodus flexuosus* Pander, 1856. (6) Views of *Drepanodus arcualus* Pander, 1856. Lower Ordovician of Baltic Provinces.

7. Genus *Scolopodus* Pander, 1856. Views and cross section of the genotype (first species) *Scolopodus sublaevis* Pander, 1856. Lower Orodovician, Baltic Provinces.

8. Genus *Oistodus* Pander, 1856. Lateral and transverse views of the genotype (first species) *Oistodus lanceolatus* Pander, 1856. Lower Ordovician of Baltic Provinces.

9. Genus *Paltodus* Pander, 1856. Three views and cross section of the genotype (first species) *Paltodus subequalis* Pander, 1856. Lower Ordovician of Baltic Provinces.

PRIONIODIDAE, new family

Conodonts somewhat pick shaped in which the handle or bar (posterior part) is denticulated and the anterior part consists of a

strongly developed main cusp usually with a variously modified undenticulated downward extension.

In this family the tooth consists of a main cusp followed posteriorly by a bar of greater or less length, denticulated along its upper margin. *Prioniodus* Pander, 1856, *Subprioniodus* Smith, 1907, *Belodus* and *Cordylodus* Pander, 1856, and *Ligonodina*, new genus, exhibit the structure characteristic of the family. In all these genera the main cusp is well marked, but the denticulated bar ranges

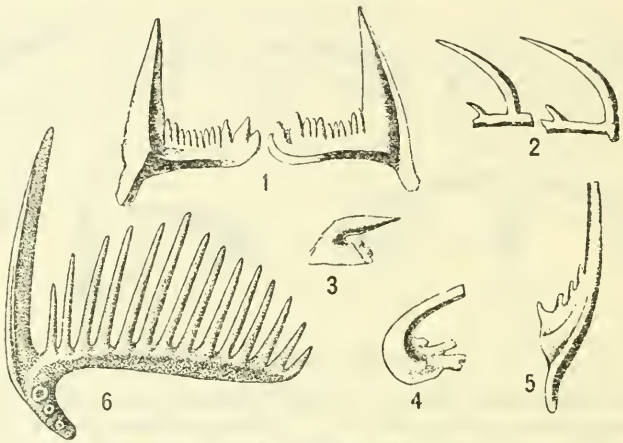

FIG. 3.—PRIONIODIDAE, NEW FAMILY

1. Genus *Prioniodus* Pander, 1856. Left and right teeth of the genotype. *Prioniodus elegans* Pander, 1856. Lower Ordovician of Baltic Provinces.
2. Genus *Subprioniodus* Smith, 1907. Two teeth of the genotype *Subproniodus paucidentatus* Smith, 1907. Ordovician (Arenig-Llandeilo, Southern Uplands of Scotland.

3, 4. Genus *Cordylodus* Pander, 1856. (3) The genotype (first species) *Cordylodus angulatus* Pander, 1856. (4) Tooth of *Cordylodus rotundatus* Pander, 1856, with denticles more developed. Both from Lower Ordovician of Baltic Provinces.

5. Genus *Belodus* Pander, 1856. The genotype (only species) *Belodus gracilis* Pander, 1856. Lower Ordovician of Baltic Provinces.
6. Genus *Ligonodina*, new genus. The genotype *Ligonodina pectinata*, new species. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

from a slight development in *Cordylodus* and *Belodus* to the maximum in *Ligonodina*. As in other conodonts, we believe the main cusp is directed backward, making the denticulated bar a posterior development.

Genus PRIONIODUS Pander, 1856

Typically the pick shape is well developed in this genus, the main terminal cusp relatively large with both edges sharp. The basal extension, although variable in length, is usually strong and

often as long as the cusp itself, the anterior line formed by both being nearly straight. Numerous denticles on the bar, their lower half or more sometimes fused, but in some cases, although always closely arranged, they remain discrete to the junction with the bar.

PRIONIODUS PARVIDENTATUS, new species

Plate 9, fig. 1

Terminal main cusp strongly inclined forward with similarly inclined closely approximated small denticles on the horizontal bar. Downward extension similar in shape and size to terminal main cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11033, U.S.N.M.

PRIONIODUS SPICATULUS, new species

Plate 9, figs. 2, 3

Differs from *Prioniodus spicatus* Hinde, 1879, of the Upper Devonian of western New York, in having the denticles on the horizontal bar much shorter and apparently of uniform size instead of more or less alternating long and short.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11035 U.S.N.M.

PRIONIODUS CULTRATUS, new species

Plate 9, fig. 7

Distinguished by its flat, broad main cusp at right angles to the bar, apparently short downward extension and denticles on bar of uneven length with the larger near the main cusp and more inclined.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11038, U.S.N.M.

PRIONIODUS PROCLINIS, new species

Plate 9, figs. 8–10

Three doubtfully conspecific teeth provisionally referred to this genus of which figure 8 is to be considered as the holotype of the species. All of these are characterized by a rather short form, six or eight rounded well-separated denticles of which the main or terminal cusp is turned decidedly forward and the downward projection is obsolete.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype and paratypes.—Cat. No. 11031, U.S.N.M.

PRIONIODUS CONCAVUS, new species

Plate 9, fig. 11

Probably closely allied to *P. proclinis* in its denticles but with a more concave base. The terminal denticle is relatively stronger and the smaller denticles are more closely arranged.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11036, U.S.N.M.

PRIONIODUS REVERSUS, new species

Plate 9, fig. 4

Similar to *P. parvidentatus* but attitude of denticles and terminal cusp reversed in that they incline backward instead of forward.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11037 U.S.N.M.

PRIONIODUS DISPARILIS, new species

Plate 9, fig. 12

In this species the terminal cusp leans forward, is very large, sharp edged with a blunt tip and a rather short downward projection. The bar is nearly straight, slender, slowly tapering, and its upper edge completely occupied by closely arranged, rather short more or less fused denticles nearly at right angles to it.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11030, U.S.N.M.

PRIONIODUS INEQUALIS, new species

Plate 9, fig. 6

Founded upon a single specimen characterized by a very long straight terminal cusp strongly inclining forward with short downward projection and short bar with two strong denticles vertical and thus diverging strongly from the main cusp. Bar short possibly incomplete.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11034, U.S.N.M.

PRIONIODUS PROCLINATUS, new species

Plate 1, fig. 22

Distinguished from its nearest allies by the great size, straightness and strong anterior inclination of the terminal cusp. The lateral

denticles, six in number, cylindrical, entirely separated, rather short, bluntly accuminate, are fairly strong and inclined in a similar degree. The bar is thin and straight and makes a rectangular junction with the uncommonly thick downward projection of the main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11240, U.S.N.M.

PRIONIODUS INUTILIS, new species

Plate 1, fig. 23

Similar to *P. proclinatus* but tooth smaller, the denticles including the main cusp rather widely separated and few in number and all more slender and less inclined forward. Downward projection is relatively longer.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11241, U.S.N.M.

PRIONIODUS ALATUS Hinde, 1879

Plate 1, figs. 25, 26

1879. *Prioniodus? alatus* HINDE, Quart. Journ. Geol. Soc. London, vol. 35, p. 361, pl. 16, fig. 5.

In this species the terminal main cusp is enormously developed both in its upward and downward extension, the bar is of moderate strength and in length about a fourth shorter than the combined length of the main cusp and basal projection. The lateral denticles are subequal, about 12 in number, confluent about one-half to three-fourths of their length as though in a sheath with bluntly acuminated terminations beyond it. They decrease quite regularly in length in the posterior half of the bar, the longest having a total length varying between a third and a half of the main cusp. Sides of main cusp are rather sharply ridged, its edges acute and the whole tooth has a somewhat flattened aspect in lateral view. The inclination of the main cusp is constant with respect to the bar and its upward extension varies somewhat in the width of its base as shown in our two views. In those in which the cusp is widest, the sheath also seems to be better developed particularly in its height.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Plesiotypes.—Cat. No. 11242, U.S.N.M.

PRIONIODUS CURVIDENS, new species

Plate 1, figs. 16, 17

Main cusp and all the denticles curve slightly toward the front. Main cusp very long, sharp edged and angulated on the side so as to

be rhomboidal in cross section. Downward projection short and thin. Bar of moderate thickness nearly straight, the denticles closely approximated without being in contact, long, slender, 10 or 11 in number, hardly half as long as the main cusp.

At first glance this species seems identical with *Euprioniodina conferta* (see pl. 3, fig. 17) but the complete preparation of the specimens established the entire absence of the denticles on the anterior basal extension in *P. curvidens*.

Occurrence.—Devonian (Rhinestreet); Shaleton, N. Y.

Cotypes.—Cat. No. 11243, U.S.N.M.

PRIONIODUS ARMATUS Hinde, 1879

1879. *Prioniodus armatus* HINDE, Quart. Journ. Geol. Soc. London, vol. 35, p. 360, pl. 15, figs. 20, 21.

We have no specimens corresponding to either of Hinde's figures which if properly drawn, represent two species quite distinct from any herein described. For the present we must assume the figures to be correct and the following four species which are of the same general type of structure are regarded as distinct.

Occurrence.—Devonian (probably Rhinestreet); North Evans, N. Y.

PRIONIODUS UNDOSUS, new species

Plate 1, figs. 18–20

This species belongs to the group in which the main cusp and the lateral denticles incline more or less forward. This particular form differs from the others in having the bar long, very slender, curved downward in the middle and its side with nodelike elevations at the base of each of the lateral denticles. The terminal main cusp is rather strong, nearly straight, longer but not greatly more so than the first three or four denticles behind it. The denticles on the bar are all very slightly curved and decrease rather regularly in length posteriorly. The downward projection is strong and its anterior side makes a straight line with the main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11244, U.S.N.M.

LIGONODINA, new genus

General form of tooth as in *Prioniodus* but distinguished by development of a series of suckerlike impressions on one side of the downward extension of the main cusp.

Genotype.—Ligonodina pectinata, new species.

Range.—Upper Devonian and Early Mississippian.

In *Ligonodina* the lateral denticles are always rounded and clearly separated from each other and there is no tendency to fusion as in *Prioniodus*. Moreover the bar is always narrower and the main cusp relatively longer, more slender, and, on the side bearing the suckerlike cavities, always shows a sharp ridge on the anterior edge of the main cusp causing a concavity just within it, while the opposite side is regularly rounded. These characters combined give the whole tooth a more delicate appearance. In addition to the new species herein described this new genus includes the following: *L.* (*Prioniodus*) *panderi* Hinde, 1879 and *L.* (*Prioniodus*) *recedens* Bryant 1921, both from the Upper Devonian of western New York.

LIGONODINA PECTINATA, new species

Plate 2, figs. 9, 10

Main cusp, including the downward extension, at least as long as the bar and arranged at approximately right angles to it. The main specific peculiarity of the species lies in the great length and slenderness of the lateral denticles, of which there are 14 or 15. The denticle next to the main cusp is almost at right angles to the bar and the succeeding ones increase their inclination very slowly to the end of the bar. The bar is sometimes slightly deflected in its terminal fifth.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotype.—Cat. No. 11245, U.S.N.M.

LIGONODINA PANDERI Hinde, 1879

Plate 2, figs. 1, 2

1879. *Prioniodus panderi* HINDE, Quart. Journ. Geol. Soc. London, vol. 35, p. 361, pl. 16, fig. 4.

Hinde's illustration as interpreted by us indicates a species with an exceedingly strong anterior cusp and relatively delicate bar with widely spaced small though probably long denticles. We have found no exact match in our collection, the nearest approach being the apparently young specimen here figured.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Pleisotype.—Cat. No. 11246, U.S.N.M.

LIGONODINA DEFLECTA, new species

Plate 2, figs. 3, 4

This interesting species of which we figure two teeth showing opposite sides, is well characterized by the curvature or deflection of the bar in the posterior half, the relatively few mostly thick

though unequal sized lateral denticles of which there are seven to nine and the thickness of the posterior half of the bar.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11247, U.S.N.M.

LIGONODINA MAGNIDENS, new species

Plate 2, figs. 5, 6

This species founded upon two teeth showing opposite sides is well characterized by the four middle denticles which are very large almost reaching the size of the main cusp. A pair of much smaller although still relatively long denticles lies on both sides of the larger set.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11248, U.S.N.M.

LIGONODINA FALCIFORMIS, new species

Plate 2, figs. 11–13

Like *L. pectinata* but the denticles are fewer and more inclined backward to the axis of the bar, the last ones being about at an angle of 50 degrees and most of them distinctly larger. The main cusp also is more curved. The furrow along the anterior edge of the main cusp is narrower and depressed beneath the level of the posterior half. In other species the opposite is the case.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11249, U.S.N.M.

LIGONODINA HINDEI, new species

Plate 2, figs. 14–16

Characterized by the much greater incurving of both the main cusp with its downward extension and the denticles and the relatively even length and strength of the lateral denticles of which there are seven. The average thickness of the lateral denticles is greater than in any of the other species here recognized. The first five are of more uniform length and size than in any other species.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11250, U.S.N.M.

LIGONODINA HIBBARDI, new species

Plate 2, figs. 7, 8

Somewhat like *L. hindei* but with a shorter and more delicate bar, fewer (five or six) and more slender denticles and the peculiar straightness of the backwardly directed main cusp. The latter

offers a further perhaps more important difference in the fact that the ridge along the anterior edge is reduced to a minimum.

This fine species is named in honor of Raymond R. Hibbard of Buffalo, N. Y., in appreciation of his enthusiastic work upon the conodonts and bryozoa.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11251, U.S.N.M.

LIGONODINA SIMPLEX, new species

Plate 9, fig. 28

The anterior end essentially as in other species of the genus except that there are no denticles on the bar, only two suckers on the downward extension of the main cusp and the main cusp more recurved than usual.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10983, U.S.N.M.

LIGONODINA TRIDENTATA, new species

Plate 9, fig. 5

Based upon a peculiar apparently perfect tooth which may be variously interpreted. It may consist of a long posteriorily fluted, non-denticulated bar terminating anteriorly in a tridentate main cusp with the denticulated portion entirely in front of the downward projecting sucker bearing extension, or the denticulated portion may be the bar and the long fluted extension may represent the main cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11029, U.S.N.M.

PRIONIODINIDAE, new family

Similar to the Prioniodidae but the base of tooth or bar is denticulated both forward and back, the main cusp thus being not terminal but set in the midst of a series of smaller denticles.

To this new family are referred *Cornuramia*, *Valentia* and *Pachysomia* Smith, 1907, *Lonchodus* and *Prionognathus* Pander, 1856, and the following ten new genera: *Prioniodina*, *Euprioniodina*, *Lonchodina*, *Prioniodella*, *Bryantodus*, *Hibbardella*, *Hindeodella*, *Diplododella*, *Palmatodella*, and *Synprioniodina*. *Lonchodus* and *Valentia* are based upon fragments at present generically indeterminable, *Prionognathus* may not prove to be a conodont at all, while nothing like *Cornuramia* or *Pachysomia* has so far been recognized in American strata.

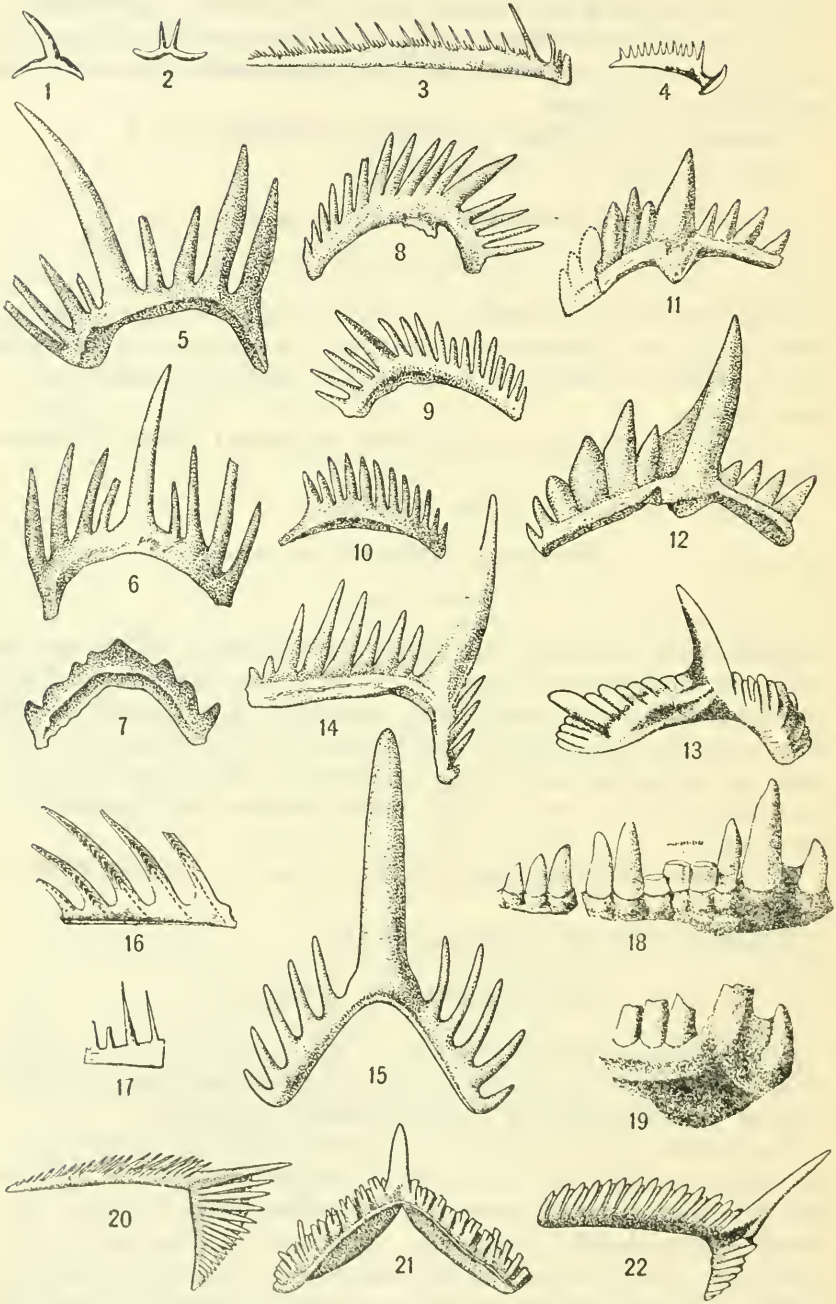

FIG. 4

(See p. 17 for explanation)

FIG. 4.—PRIONIODINIDAE, new family

1, 2. Genus *Cornuramia* Smith, 1907. (1) Genotype *Cornuramia monodonta* Smith, 1907. (2) *Cornuramia diplodonta* Smith, 1907. Both from the Ordovician (Arenig-Llandeilo), Ravengill, Scotland.

3. Genus *Hindeodella*, new genus. Genotype *Hindeodella subtilis*, new species, × 20. Base of Mississippian (Hardin sandstone), Mount Pleasant, Tenn.

4. Genus *Pachysomia* Smith, 1907. Genotype *Pachysomia wanlockensis* Smith, 1907. Ordovician (Arenig-Llandeilo), Wanlock Water, Scotland.

5–7. Genus *Lonchodina*, new genus. Genotype. *Lonchodina typicalis*, new species. Views of opposite sides of teeth and of the under surface of bar illustrating curvature, × 20. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

8, 9. Genus *Prioniodina*, new genus. Genotype, *Prioniodina subcurvata*, new species, × 20. Teeth viewed from opposite sides. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

10. Genus *Prioniodella*, new genus. Genotype, *Prioniodella normalis*, new species, × 20. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

11–13. Genus *Bryantodus*, new genus. (11, 12) Genotype, *Bryantodus typicus*, new species, × 20, Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y. (13) *Bryantodus nelsoni*, new species, × 20, an aberrant species of the genus. Mississippian (Hardin sandstone at base of Chattanooga shale), Mount Pleasant, Tenn.

14. Genus *Euprioniodina*, new genus. Genotype *Euprioniodina deflecta*, new species, × 20. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

15. Genus *Hibbardella*, new genus. Genotype, *Hibbardella angulata* Hinde, 1879, × 20. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

16. Genus *Lonchodus* Pander, 1856. (*Centrodus* Pander, 1856, preoccupied.) Genotype, *Lonchodus* (*Centrodus*) *simplex* Pander, 1856. Carboniferous of Russia.

17. Genus *Valentia* Smith, 1907. Genotype, *Valentia morrochensis* Smith, 1907. Ordovician (Arenig-Llandeilo), Morroch Bay, Scotland.

18–19. Genus *Prionognathus* Pander, 1856. Views of opposite sides of the genotype *Prionognathus brandtii* Pander, 1856. Silurian, Island of Oesel. Probably not a conodont.

20. Genus *Palmatodella* new genus. Genotype, *Palmatodella delicatula*, new species, × 20. Mississippian (Chattanooga shale), 13 miles east of north of Huntsville, Ala.

21. Genus *Diplododella*, new genus. Genotype, *Diplododella bilateralis*, new species, × 20. Mississippian (Chattanooga shale), 13 miles east of north of Huntsville, Ala.

22. Genus *Synprioniodina*, new genus. *Synprioniodina alternata*, new species, × 20. Mississippian (Chattanooga shale), 13 miles east of north of Huntsville, Ala.

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PRIONIODINA, new genus

Base of tooth more or less curved, crowned with numerous, subparallel, rounded, discrete denticles all inclined in one direction, one of which located in the median third, is considerably larger than the others.

Genotype.—*Prioniodina subcurvata*, new species.

Range.—Upper Devonian, Early Mississippian.

To this new genus the following previously described species are referred *Prioniodus geminus* Hinde, 1900, *P. recedens* Bryant, 1921 and *P. volborthii* Pander, 1856.

PRIONIODINA SUBCURVATA, new species

Plate 4, figs. 22, 23, 24

Tooth consisting of a strongly curved bar surmounted by about 18 denticles, all of which are of subequal size and uniformly separated except the fourth or fifth from the shorter end, regarded as the main cusp, which occupies nearly the space of two others and projects to a moderate extent beyond their tips.

Occurrence.—Devonian (Rhinestreet shale): Shaleton, N. Y.

Cotypes.—Cat. No. 11252, U.S.N.M.

PRIONIODINA SEPARATA, new species

Plate 4, figs. 17, 18

Like *P. subcurvata* but the main cusp is more median in position and relatively smaller, the denticles are more slender, less tapering, and their bases more widely expanded. Moreover the bar is less curved.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11253, U.S.N.M.

PRIONIODELLA, new genus

Like *Prioniodina* except that the denticles are subequal, none being particularly larger than the other.

One end of the bar supposed to be the posterior because of the slant of the denticles, is commonly produced into a blunt process. The denticles are always close, either discrete throughout or more or less coalescent, agreeing in the latter feature with *Bryantodus*. The lack of a readily distinguishable main cusp separates this genus from both *Prioniodina* and *Bryantodus*.

Genotype.—*Prioniodella normalis*, new species.

Range.—Upper Devonian, Early Mississippian.

In addition to the species here described, *Centrodus invalidus* Bryant apparently belongs to this genus.

PRIONIODELLA NORMALIS, new species

Plate 4, figs. 1, 1′

The moderately curved bar, relatively strongly produced posteriorly, bearing 12 or 13 denticles with the strongest in the posterior half, from which point they diminish in strength although not greatly in length to the anterior extremity, is characteristic of this species. The denticles are compressed rounded, closely arranged, but remain separated practically to their bases.

Occurrence—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11254, U.S.N.M.

PRIONIODELLA INAEQUALIS, new species

Plate 4, figs. 2, 3

General shape as in *P. normalis*, except that the posterior extremity terminates more bluntly and the denticles are flatter, coalesced, and very unequal and irregular in size. The anterior denticles are shorter and those of the middle half have an average size much greater both in width and height than those in the terminal quarter.

Occurrence—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11255, U.S.N.M.

PRIONIODELLA AEQUIDENS, new species

Plate 4, figs. 6, 7

Similar to *P. normalis* but bar is more curved, apparently without a distinct posterior projection, with numerous subequal and very closely approximated, largely confluent denticles.

Occurrence.—Devonian (Rhinestreet) ; Shaleton, N. Y.

Holotype.—Cat. No. 11256, U.S.N.M.

PRIONIODELLA MULTIDENS, new species

Plate 4, figs. 4, 5

Based upon a very small tooth the bar of which is relatively wide, the denticles very small, numerous (21 or 22) relatively very short and of approximately the same size except that a few may be wider although not otherwise distinguishable. Although very close together, the denticles seem to be separated from each other.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11257, U.S.N.M.

PRIONIODELLA INFORMATA, new species

Plate 10, figs. 19, 20

Tooth slightly bowed with basal outline almost straight, slender spinelike denticles on upper side increasing in length from either side to the middle. Denticles separated by a little more than their own width and occasionally a small denticle between each pair of larger ones. One end of bar somewhat rounded.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10991, U.S.N.M.

PRIONIODELLA BREVISPINA, new species

Plate 10, fig. 21

Characterized by the thick bar, relatively short length with one end (presumably anterior) much wider and blunter than the other, and subequal size of denticles with every third and fourth one slightly larger. In all, fifteen denticles with one or two at either end shorter and much smaller than all the others.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Holotype.—Cat. No. 10993, U.S.N.M.

PRIONIODELLA GRACILIS, new species

Plate 10, figs. 22, 23

Bar rather slender, of moderate length with a short spinelike downward projection at its wider end. Upper side crowned with about 9 long, slender, separated denticles with a moderate backward inclination.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10992, U.S.N.M.

PRIONIODELLA ROBUSTA, new species

Plate 10, fig. 24

Distinguished from *P. gracilis* by its stronger and quite erect denticles. The species also shows no sign of the anterior spurlike downward projection.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Holotype.—Cat. No. 10990, U.S.N.M.

PRIONIODELLA CONFERTA, new species

Plate 10, fig. 25

Especially distinguished from other species of this genus by its strong, closely approximated denticles set obliquely to the bar. The lower half of the denticles is concave and seems to be set into a transversely striated, outwardly concave sheath, therein suggesting the confluent denticles characterizing *Bryantodus*. However, none of the denticles can be distinguished as the main cusp which is always strongly indicated in *Bryantodus*.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10989, U.S.N.M.

BRYANTODUS, new genus

Like *Prioniodina*, but denticles with sharp, laterally confluent edges. The main cusp is proportionately much larger and as a rule more conspicuous in its width and broadly expanded sides confluent with the adjacent denticles. The base forms a narrow flange-like expansion on both sides, with a characteristic downward projection on the inner side beneath the main cusp, serving perhaps for securing attachment in the jaw of the animal. The denticles are connected by a membrane-like extension of their edges, a feature much better developed in this genus than in the otherwise related genus *Prioniodina*.

Genotype.—*Bryantodus typicus*, new species.

This new generic name is in recognition of the studies upon fossil fishes by W. L. Bryant, director of the Park Museum, Providence, R. I.

Range.—Upper Devonian and Early Mississippian.

Of previously described species, *Prioniodus cristatus*, *P. macrodentatus*, *P. obtusus*, *P. parvulus*, *P. parvus*, *P. retusus*, and *P. spatulatus* Bryant, 1921, *Polygnathus dubius* Smith, 1907, *Polygnathus duplicatus P. immersus* and *P. radiatus* Hinde, 1879, and *Prioniodus politus* Hinde, 1879, belong to *Bryantodus*.

BRYANTODUS TYPICUS, new species

Plate 6, figs. 11, 12

Bar slightly curved, with an accentuated downward turn at the anterior extremity, surmounted by 10 relatively short, flat, confluent denticles setting well back from the flange-like expansion of the bar. Main cusp strong, nearly three times as wide at the base as any other denticle, slightly recurved toward its top, with thin, sharp edges, the latter appearing on the inner side of tooth like a mem-

branous connection with the denticle behind it. Usually five short, broad, confluent denticles, with spear-like terminations posterior to the main cusp and four less confluent and more elongate conical denticles on the anterior side. Downward projection of bar below main cusp well developed. Of the posterior denticles, the second and third from the main cusp are wider than the others, the last two being quite small.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotype.—Cat. No. 11258, U.S.N.M.

BRYANTODUS? TRIDENTATUS, new species

Plate 6, fig. 13

Easily recognized in that the tooth consists of three broad based, thin edged denticles gradually increasing in size to the largest which is regarded as the main cusp and by the complete absence of the bar and denticles posterior to this. There is no indication that the absence of the posterior part is due to imperfection of the specimen. The species is only provisionally referred here pending the discovery of other forms of similar nature.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11259, U.S.N.M.

BRYANTODUS? INEQUALIS, new species

Plate 6, fig. 14

Readily distinguished by the extreme difference between the size of the lateral series of denticles and the main cusp. The lateral series of denticles are all fused but those on the shorter (anterior?) side five in number merging into the base of the main cusp, are much smaller and seem almost a part of it while seven making the longer series are more definitely separated although also with confluent edges.

This species seems to be an aberrant type with possible prophetic relations to the Mississippian genus *Palmatodella.*

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11260, U.S.N.M.

BRYANTODUS MULTIDENS, new species

Plate 6, figs. 15, 16

Our figures are of two teeth showing opposite sides, the inner (15) and the outer (16), and illustrate differences to be noticed in such views. The tooth is longer with respect to the height than in any other species. The denticles are developed normally for this

genus but those on the two sides of the main cusp are bilaterally much more equal in size and more numerous than in other species, there being at least ten on each side. The main cusp is very broad and the membrane-like connection with the contiguous denticles is mainly shown in the outer side. Further the main cusp is shorter and projects less beyond the tips of the lateral denticles than in any of the other species.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11261, U.S.N.M.

BRYANTODUS CRASSIDENS, new species

Plate 6, figs. 17, 18

Similar to *B. typicus* but differs in its more regular curvature and more uniform development of the denticles, giving them a neater aspect on the whole. The basal part of the main cusp is thicker on both sides but especially on the inner side where the membranelike connection with the adjacent denticles is much less evident. The species differs from most others in the great thickness of the denticles near the base and their relative shortness and their greater length and also straighter extremities. The denticles are also fewer than usual with seven or eight behind the main cusp gradually diminishing posteriorily and usually four anteriorily increasing in front of it.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11263, U.S.N.M.

BRYANTODUS OBLIQUUS, new species

Plate 6, figs. 19–21

Distinguished from *B. crassidens* in having somewhat longer denticles more curved in an anterior direction and particularly in that the ones in front of the main cusp decrease in size anteriorily instead of the reverse.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11264, U.S.N.M.

BRYANTODUS SINUATUS, new species

Plate, 6, figs. 22–24

Evidently a close ally of *B. obliquus* from which it differs particularly in the straighter bar, more sinuate base and the decided projection of the portion beneath the main cusp, the latter feature causing the appearance of a shallow sinus on each side; also in the narrower and more cylindrical section of the denticles with longer and more acuminate terminations. The main cusp is also longer than in that species and not so wide. Other difference may be noted

on comparison of the figures. One of the specimens shows minute fluting on the underside of the bar.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11265, U.S.N.M.

BRYANTODUS NITIDUS, new species

Plate 4, figs. 12–14

This neat species as based upon Figures 12 and 13 is characterized by the rather strong even curvature of the bar, prominence although not great size of the main cusp, numerous, subequal, outwardly diminishing denticles all inclined toward the posterior end and the small size of the protuberance on the under side of the bar immediately beneath the main cusp. Both specimens have 13 denticles behind and about 10 in front of the main cusp. Figure 14 represents a specimen referred here with doubt for reasons apparent upon inspection of the photograph. This species belongs to a group better developed in the Mississippian black shales.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11266, U.S.N.M.

BRYANTODUS CONJUNCTUS, new species

Plate 4, figs. 8, 9

Curvature of bar uncommonly strong. Main cusp of moderate size, sharp edged but apparently terminating bluntly, with 10 or 11 flat, convex coalescent denticles on each side.

The strong curvature of the bar and the rather short and not large main cusp with an equal number of numerous denticles on each side will sufficiently distinguish this species which, however, is not to be counted as a typical species of the genus.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11267, U.S.N.M.

BRYANTODUS SEMISEPARATUS, new species

Plate 4, fig. 10

Bar rather strongly curved, main cusp slender, very long coalescing with the shorter denticle immediately in front, and this with all the others to the anterior extremity. Posterior denticles long, slender, seven in number, and all separate.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11268, U.S.N.M.

BRYANTODUS NORMALIS, new species

Plate 4, figs. 25, 26, and 27

Allied to *B. crassidens*, *B. obliquus*, and *B. sinuatus* but more particularly to the first from which it differs in having both the lateral

series of denticles relatively smaller, the disproportion in size being especially apparent in those close to the base of the main cusp. It differs from the other two mentioned in the straightness and somewhat broader base of the main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11269, U.S.N.M.

BRYANTODUS COALESCENS, new species

Plate 4, fig. 28

Distinguished from all others by the merging of four or five denticles adjacent to the main cusp so that it gives the appearance of an enormously broad, rapidly tapering triangular main cusp. The base is rather strongly curved, especially at the outer extremity of the long end which is also uncommonly long as compared to the posterior part. The latter carries three or four slightly projecting, posteriorly diminishing, coalescent denticles. In the anterior end there are five thick anteriorly diminishing denticles beyond those merged into the base of the main cusp, the first being the largest.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11270, U.S.N.M.

BRYANTODUS INSOLENS, new species

Plate 10, fig. 17

Tooth rather slender, the shorter end incurved and its extremity rounded upward, with the median cusp large, prominent, and truncated bluntly, with 5 or 6 denticles on one side (anterior) and 12 or more on the other, all denticles closely arranged.

This new species is similar to *B. nelsoni* and with it forms a section of the genus that in the shape of its anterior end has a resemblance to *Hindeodella.*

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11015, U.S.N.M.

BRYANTODUS GERMANUS, new species

Plate 10, fig. 18

Related to *B. subradiatus* but with a more expanded base, having small wart-like elevations on its upper surface. The denticulated part is distinguished by the spatulate form of the main cusp and the great inequality in the denticles on opposite sides of it.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11016 U.S.N.M.

BRYANTODUS TENUIS, new species

Plate 10, fig. 7

This differs from all other species of the genus in the narrowness of the bar and the minute denticles which are closely arranged on one half and farther apart on the other. The main cusp is distinguishable but not conspicuously different from the separated denticles.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11025 U.S.N.M.

BRYANTODUS TRANSITANS, new species

Plate 4, figs. 10, 11

This species has a general resemblance in the curvature of the bar, and size and arrangement of the denticles to *Prioniodella aequidens* but it is readily distinguished by the development of one of the median denticles as a main cusp with flattened edges which fuse somewhat with neighboring denticles.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotype.—Cat. No. 11262, U.S.N.M.

BRYANTODUS CURVATUS, new species

Plate 4, figs. 19, 20

This species is intermediate in its characters between *Prioniodina* and *Bryantodus*, the complete separation of the denticles being as in the former and the sharp lateral edges of the main cusp as in the latter. It may be viewed as a further step in the transition between the two genera from that seen in *Bryantodus semiseparatus* in which fusion of the posterior denticles still occurs. *Prioniodina subcurvata* has a similar form but has a rounded main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotype.—Cat. No. 11271, U.S.N.M.

BRYANTODUS SUBRADIATUS, new species

Plate 10, figs. 12, 13

Similar to *B. radiatus* Hinde, 1879, from the Genesee shale of western New York but differs in the much smaller size of the main cusp, in the more uniform size of the denticles and in lacking the protuberance beneath the main cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11022, U.S.N.M.

BRYANTODUS MINUTUS, new species

Plate 10, fig. 6

Characterized by the relatively very large size of the sharp edged main cusp and inconspicuous development of the denticles on the two sides of the base. On the thicker end of the bar there are three more or less confluent denticles, likewise three but more or less separated ones on the smaller end. The chief characteristic of this species besides its minute size, is the great disparity in the size of the denticles and the main cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11018, U.S.N.M.

BRYANTODUS CRASSUS, new species

Plate 10, fig. 14

Founded on a broken tooth which differs from others in the greater strength of its bar with a distinct knob beneath the median cusp which latter is larger and peculiarly directed. The lateral denticles are rather small.

Occurence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11026, U.S.N.M.

BRYANTODUS GRACILIS, new species

Plate 10, fig. 10

Similar to *B. subradiatus* but tooth on the whole more slender, denticles smaller and more numerous and main cusp relatively much thicker and probably longer.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11021, U.S.N.M.

BRYANTODUS PERGRACILIS, new species

Plate 10, fig. 11

More slender than *B. gracilis*, whole tooth straighter and lateral denticles more uniform in size at the two ends of bar.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11023, U.S.N.M.

BRYANTODUS INCERTUS, new species

Plate 10, fig. 8

Founded upon the inner side of a nearly complete tooth distinguished from all others of this genus by its broadly curved form

and its enormous sharp-edged median cusp, the base of which lies toward the inner side of the bar. The denticles on the two ends of the bar are set farther forward toward the outside of the bar. All of these are, as usual in the genus, sharp edged and in part confluent with five rather short broad-based denticles on the shorter end and five similar but larger and longer denticles occupying the outer two-thirds of the longer ends of the bar. Finally, four or five minute denticles are between the latter and the base of the main cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11019, U.S.N.M.

BRYANTODUS NELSONI, new species

Plate 10, fig. 9

Bar rather thick, slightly curved, the anterior half curved downward and inward with numerous laterally confluent denticles (9–12). Main cusp large, thick, very prominent bent somewhat backward. Posterior end of bar with large, less curved although otherwise similar denticles as on anterior end.

This species, as well as *Bryantodus insolens*, belongs to a peculiar group of the genus suggesting in the form of the part in front of the main cusp the corresponding part of *Hindeodella*.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11020, U.S.N.M.

BRYANTODUS SUBBREVIS, new species

Plate 10, fig. 15, 16

Our figures represent opposite teeth of this new species showing the short form slight curvature of base, semiovate outline and decidedly recurved denticles which distinguish it from *B. radiatus* and its allies.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11027, U.S.N.M.

BRYANTODUS CURVATULUS, new species

Plate 9, fig. 13

Tooth curved tapering rapidly backward, the anterior end unknown, broken. The posterior denticles about 10 compactly arranged, inclining forward, subequal in size, the main cusp not greatly longer but considerably wider than the others.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11032, U.S.N.M.

EUPRIONIODINA, new genus

Like *Prionodina* but main cusp much more produced and interior part of bar, smaller, shorter, more sharply deflected and carrying on its upper edge a series of closely arranged denticles.

Genotype.—*E. deflecta*, new species.

Range.—Upper Devonian, Mississippian.

Because of the denticulated anterior part of the bar this genus falls in the Prioniodinidae but the general aspect is that of a *Prioniodus* with the downward projection of the main cusp bearing denticles. If not properly prepared, specimens are liable to be confused with *Prioniodus*. *Prioniodus acicularis*, *P. furcatus*, and *P. radicans* Hinde, 1879, *P. alatus*, and *P. discedens* Hadding, 1913, and *P. lanceolatus* and *P. curvatus* Smith, 1907, appear to belong to this genus judging from their illustrations.

EUPRIONIODINA DEFLECTA, new species

Plate 3, figs. 11, 12

Tooth with the main cusp and posterior extension of bar having the general aspect of *Prioniodus* but the anterior downward projection is not simple, as it carries three or four small denticles. Main cusp slightly curved posteriorily, although on the whole inclining forward. Posterior extension of bar with eight somewhat unequal but fairly stout denticles, the largest of which may be approximately half the length of the main cusp. Downward projection of bar about rectangular to the axis of the bar and about half as long.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11272, N.S.N.M.

EUPRIONIODINA CONFERTA, new species

Plate 3, fig. 17

Distinguished by the considerable width, unusual flatness, sharp edges and decided anterior curving of the main cusp and the more closely arranged posterior lateral denticles which are twelve in number. Anterior denticles three, small and short. The downward extension is relatively small and directed somewhat anteriorly making an angle of about 110 degrees.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11273, U.S.N.M.

EUPRIONIODINA BRYANTI, new species

Plate 3, figs. 13, 14; Plate 1, fig. 21

Similar to *E. deflecta* but both main cusp and denticles are on the whole more slender, farther apart and the largest of the latter relatively longer reaching almost two thirds the length of the main

cusp. Base of the main cusp considerably narrower and set a little lower with respect to the top of the bar and at once turns upward. In specimens of the same size, the posterior bar is wide. The anterior downward projection bends further posteriorly, making less of a right angle with the bar while in *E. deflecta* this angle is 5 to 10 degrees more than a right angle. Also the whole posterior part of the bar is slightly but distinctly arcuate.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11274, U.S.N.M.

EUPRIONIODINA PERANGULATA, new species

Plate 3, fig. 10

Tooth developed almost equilaterally as in *Hibbardella* but when carefully examined it is found that the two lateral extensions are not equal the anterior one being the longer of the two and carrying six short, blunt (possibly evenly broken) closely spaced denticles whereas the other end of the bar carries four with a minute one between the first and the second, much longer, well separated straight denticles. Moreover the main cusp is very slightly curved. All of these characters suggest *Euprioniodina* and compared with other species of this genus this one is readily recognized by its sharp angulation and the reversal in length of the lateral extensions of the bar.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotypes.—Cat. No. 11275, U.S.N.M.

EUPRIONIODINA PECULIARIS, new species

Plate 10, fig 3

Founded upon a single practically complete specimen showing the inner side of tooth. It consists of a rather thin, basally excavated, strongly bent plate carrying on the upper surface of the posterior half a series of strong bluntly tapering denticles all more or less backwardly inclined and terminating near the middle of the whole tooth in a cusp which is much larger than the others. In front of this is a space without denticles and then a series of about seven denticles much smaller than those on the posterior half.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Holotype.—Cat. No. 11017, U.S.N.M.

LONCHODINA, new genus

Like *Euprioniodina* but ends of bar more equal in length and the entire bar strongly bowed, bent in two directions one with the usual upward curvature at the middle and the other outwardly as seen in

a view of the underside of the base; denticles more irregular and farther separated. Main cusp sometimes not readily distinguished from the denticles.

The main characteristics of this genus are its outwardly bowed form, the greater length and separation of the rounded needle-shaped denticles, and their usually unsymmetrical arrangement. The bowing of the tooth is especially characteristic, this occurring in two directions, upward and outward.

Genotype.—*L. typicalis*, new species.

Range.—Upper Devonian and Early Mississippian.

LONCHODINA TYPICALIS, new species

Plate 5, figs. 1, 2

The curved and outwardly bowed bar is thin and carries on its upper edge first a strong median cusp and on each side of this four or five denticles outwardly increasing in length and thickness, the first denticles being small and the others becoming two-thirds the size of the main cusp. Ends of bar curved down but the anterior end is longer and more downward projecting than the others. Lateral denticles require more and more of a curve to assume the erect position characteristic of their upper half.

This species is especially characterized by the nearly equilateral development of the denticles on each side of the main cusp, their strength, erect habits of their tips, and their curvature increasing successively away from the median cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11276, U.S.N.M.

LONCHODINA SEPARATA, new species

Plate 5, fig. 12

In separation and relative uniform size of denticles allied to *L. delicatula* but tooth on the whole shorter with fewer denticles on each side of the main cusp and especially on the posterior side (four on the anterior and only two or possibly three on the posterior side). Also in that the denticles of the anterior half decrease rather regularly in length outwardly whereas in *L. delicatula* they increase in this direction.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11277, U.S.N.M.

LONCHODINA RECTIDENS, new species

Plate 5, figs. 13, 14

Bar short, strongly curved and bowed, bearing long straight diverging, closely arranged denticles with four rather small ones on

one end of equal size and three or four of larger though irregular sizes in middle part of tooth and two relatively small ones on the other end. It is difficult to pick out the main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11278, U.S.N.M.

LONCHODINA ARCUATA, new species

Plate 5, fig. 15

Bar strongly arcuate, curved so that the extremities are at approximately right angles, bearing an anterior series of denticles all curving inward, the others beginning with the main cusp, straight and excepting the one nearest the main cusp diminishing outwardly in size. These characteristics especially the arcuate bar, readily distinguish this species.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11279, U.S.N.M.

LONCHODINA BILATERALIS, new species

Plate 5, fig. 18

Bar with subequally down-curved extremities, crowned by 11 straight diverging denticles of which 2 are very large and nearly equal in size, 3 outwardly diminishing denticles on one side, 2 or 3 between the large pair and 4 much smaller ones on the other end. Except the last, which are also slender, all the other teeth are thick, joined below and taper rapidly toward their extremities.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11280, U.S.N.M.

LONCHODINA PERLONGA, new species

Plate 5, figs. 6, 7

Similar to the genotype *L. typicalis*, but all the denticles are more slender, relatively longer, with one or two more on either side of the median cusp. All the denticles are slightly curved and divergent toward their tips. Moreover, they are closer together, although remaining separate to the bar.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11280, U.S.N.M.

LONCHODINA SUBANGULATA, new species

Plate 5, fig. 3

Similar to *L. perlonga* except that the bar is angulated, the denticles are closer together, and the main cusp, though little curved,

bends backward so strongly that it is almost parallel with the direction of the anterior half of the bar. Five or six denticles on the anterior part of the bar, all curved backward. On the posterior side of the main cusp eight or possibly nine denticles all straight, relatively equal in size and length and paralleling in direction the main cusp.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11282, U.S.N.M.

LONCHODINA SUBRECTA, new species

Plate 5, figs. 4, 5

Distinguished from *L. typicalis* by its much less bilateral development and less regular arrangement of the denticles. The outer denticles are much smaller than the inner ones and throughout are very little curved so that their tips diverge with respect to the median cusp. Two of the anterior denticles flanked by one or two smaller denticles and the main cusp with two small denticles on the other end approach the main cusp in size, whereas the posterior series consists of four much smaller and nearly equal denticles, thus causing the lack of bilaterality.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11283, U.S.N.M.

LONCHODINA DELICATULA, new species

Plate 5, fig. 11

Curvature of bar about as in *L. typicalis*, which it resembles in general and from which it differs as it does from all other species of the genus here recognized in the exceeding slenderness and wide separation of the denticles. The main cusp shares in this slenderness and is moreover somewhat sharp edged. The denticles are more nearly of a uniform size than any of the species to which it is allied.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11284, U.S.N.M.

LONCHODINA PERARCUATA, new species

Plate 5, fig. 19

Bar horseshoe shaped, the anterior half with about nine rather rapidly tapering curved denticles. The main cusp in the middle of the curved bar, a small denticle next, succeeded by two nearly equalling the main cusp in size and finally by two very small ones.

The outstanding characteristic of this species is the exceeding curvature of the bar. In other respects it reminds of *L. bilateralis*

and *L. rectidens*, but not sufficiently to render confusion with them at all likely.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11285, U.S.N.M.

LONCHODINA PAUCIDENS, new species

Plate 6, fig. 1

This species is founded on an exceedingly delicate tooth, distinguished from all others by its curved bar and very few subequal slender, straggly denticles. Its nearest relatives probably are *L. subangulata*, *L. separata*, and *L. projecta*, but in each case the differences are such that detailed comparisons seem unnecessary.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11286, U.S.N.M.

LONCHODINA SUBSYMMETRICA, new species

Plate 6, figs. 5, 6, 7; plate 5, fig. 8; and plate 1, fig. 24

Like *L. perlonga*, but all the denticles are shorter, and the main cusp is not only shorter but much stronger in its lower half and is situated on the posterior side instead of the anterior. There are thus only five denticles behind the main cusp and usually seven in front of it, instead of nine behind and five in front, as in *L. perlonga*.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11287, U.S.N.M.

LONCHODINA ABNORMIS, new species

Plate 6, figs. 8–10

Readily distinguished from all the associated forms by its relatively short, basally nearly straight, and medially thick bar, with few denticles on each side of a large, moderately recurved cusp. Usually three denticles in front of the main cusp and one at its base, which shows only on the inner side, and two behind the main cusp.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11288, U.S.N.M.

LONCHODINA TRANSVERSA, new species

Plate 6, figs. 2, 3

In this species the bar is uncommonly long and straight and the denticles show practically no curvature. The species reminds of *Hibbardella* but the main cusp is not in the middle nor directly over the swelling in the bar as in that genus. The main cusp is

long cylindrical slightly flattened at the rapidly tapering extremity. Six to nine denticles on the longer end of bar and usually four on the shorter, cylindrical and their bases separated by fully their own diameter. The relative straightness of the bar readily characterizes this species which in no other respects is much like *L. perlonga* although the denticles are shorter throughout.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11289, U.S.N.M.

LONCHODINA ALTERNATA, new species

Plate 6, fig. 4

Similar in angulation of the bar to *L. arcuata* and *L. subangulata* but readily distinguished from both of them by the very unequal, alternating size of the denticles on the posterior part. There are minor differences in the trend of the curvature of the main cusp and other points which are brought out in the illustration.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11290, U.S.N.M.

LONCHODINA? INCREBESCENS, new species

Plate 5, fig. 20; Plate 3, figs. 15, 16

Tooth strongly bowed outward but the distinct separation of the main cusp and its strong denticulated downward projection (anterior end of bar) suggests *Euprioniodina*. The very considerable strength of the denticles on both ends of the bar decided the provisional placement under *Lonchodina*. On account of the bowed form the tooth is usually broken but unless broken so that the two ends of bar separate and lie more nearly in a plane than natural the denticles of the anterior end are not visible in a view of the convex side.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11291, U.S.N.M.

LONCHODINA? PROJECTA, new species

Plate 5, figs. 9, 10

The main cusp and anterior set of denticles are similar to *L. subangulata* except that all of the denticles are relatively larger and somewhat farther apart and the main cusp is flatter with a suggestion of sharp edges. The main difference lies in the uncommon brevity of the posterior end which is about half as long as the anterior and carries only two or three subequal denticl s.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11292, U.S.N.M.

LONCHODINA? PRONA, new species

Plate 5, figs. 16, 17

Like *L. projecta* but the main cusp is thicker and longer and the other denticles more numerous, smaller, and closer together with seven or eight in front and five behind the main cusp. In some respects it is like *L. subangulata* but the anterior denticles are more numerous and relatively smaller, the main cusp is much thicker and sharp edged instead of rounded, and the posterior denticles fewer with but five instead of seven or eight.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Cotypes.—Cat. No. 11293, U.S.N.M.

LONCHODINA GENICULATA, new species

Plate 4, fig. 15

Like *L. subangulata* but the bar is even more sharply bent, the angle being almost rectangular and the denticles on the anterior part more sharply recurved, the main cusp being on a line with the anterior half of the bar. The main cusp is relatively shorter and somewhat sharp edged and the disproportion between its length and the denticles on the posterior part of bar is much less. The length of all but the first of the six posterior denticles is nearly or quite the same as that of the main cusp itself. The species resembles certain forms of *Prioniodina* like *P. subcurvata* but the bar is more strongly bowed outwardly, thicker, and the denticles more equal in length and all the lateral ones longer than in that species. In the bowing of the bar this is a true *Lonchodina.*

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11294, U.S.N.M.

LONCHODINA DISCRETA, new species

Plate 10, figs. 1, 2

Based upon a young example and a large tooth of this species distinguished by the considerably curved bar and the denticles definitely separated from each other by spaces one to three times their own width. One subcentrally situated denticle may be called the main cusp being relatively larger and longer than the others. This is two to three times larger than the others and moderately recurved.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11014. U.S.N.M.

LONCHODINA RECTANGULATA, new species

Plate 10, fig. 4

Tooth strongly bowed with well separated denticles, the outer ones rather prominent and growing gradually smaller toward the middle. Species mainly characterized by the fact that the median teeth are smaller than in other species of this genus and also in lacking anything that can be compared to a major cusp.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11024, U.S.N.M.

HIBBARDELLA, new genus

Anterior and posterior ends equally developed in structure and angle to the axis of the main central cusp, the tooth thus being bilaterally symmetrical. Main cusp sharp edged, erect, and enormously developed, especially in its length. Lateral denticles are always separated, slightly curved inward, usually few, but varying considerably in number and length in different species.

Genotype.—Hibbardella (*Prioniodus*) *angulata* Hinde, 1879.

Range.—Upper Devonian and Early Mississippian.

This interesting new genus is named in honor of Raymond R. Hibbard, of Buffalo, N. Y., in recognition of his enthusiastic work upon the conodonts and other microfossils.

HIBBARDELLA ANGULATA Hinde, 1879

Plate 3, figs. 1–4

1879. *Prioniodus angulatus* HINDE, Quart-Journ. Geol. Soc. London, vol. 35, p. 360, pl. 15, fig. 17.

Even though our illustrations do not agree in all features with Hinde's figure, which was based upon an incomplete specimen, we feel certain of our correctness in identifying his species with the most abundant form of this generic type from the same horizon. In his figure the main cusp is narrower and the bar thicker, but we believe these differences are due to inaccurate drafting. Besides, as shown by our figures, the species is subject to considerable variation in the proportions of the bar and the relative size of the denticles on the latter. The main cusp has the usual character of sharp edges, one of the surfaces rounded, the other with a more or less well developed median angulation. The angle made by the two diverging parts of the bar is usually less than a rectangle, but varies from 80 to 90 degrees. The number of the lateral denticles is usually about five.

Occurrence.—Devonian (Rhinestreet): Eighteen Mile Creek and Shaleton, N. Y.

Pleisotypes.—Cat. No. 11295, U.S.N.M.

HIBBARDELLA SUBEQUALIS, new species

Plate 3, figs. 6, 7

Compared with *H. angulata*, in this new species the main cusp is relatively shorter, tapers throughout its length instead of being parallel sided, the bar is much thicker and the denticles on the whole more numerous (7) and more slender, more closely spaced, and the increase in size outwardly is more pronounced. The base is more arcuate, and the angle of the two sides is somewhat wider.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11296, U.S.N.M.

HIBBARDELLA MULTIDENS, new species

Plate 3, figs. 8, 9

In this species the angulation of the bar is less making a much wider angle between the arms, each of which is longer and carries nine relatively short denticles in all the specimens seen. The major cusp is very long, slender, parallel sided and seems particularly extended on account of the shortness of the lateral denticles. The flange at the base of the main cusp on the convex side is more clearly indicated than in other species.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11297, U.S.N.M.

HIBBARDELLA? CONFERTISSIMA, new species

Plate 3, fig. 5

Although apparently bilaterally symmetrical and consisting of a larger central main cusp with smaller denticles on each side, in which respect it agrees with *Hibbardella*, this species in the closeness of the denticles and other features must be placed here doubtfully. More specimens may show a closer relationship to such genera as *Euprioniodina*, *Synprioniodina*, and *Diplododella*. The species is so distinct from the associated forms that in spite of its doubtful generic affiliations we believe it worthy of description.

Occurrence.—Devonian (Rhinestreet): Shaleton, Erie County, N. Y.

Holotype.—Cat. No. 11298, U.S.N.M.

HINDEODELLA, new genus

Bar long and straight, bearing as many as ten small denticles in front of the strong long main cusp and a long series of numerous small slender denticles often alternating in size behind it, those of each set approximately equal in size.

Genotype.—Hindeodella subtilis, new species.

Range.—Upper Devonian and Early Mississippian.

This genus includes a number of species with relations on one side to *Lonchodina* and perhaps more particularly to *Prioniodina* and on the other to *Prioniodus* but with other characters that are distinctly its own. Most of the species have a nearly straight bar but have a relatively strong and very long denticle near the broader end with a long series of smaller denticles, typically in alternating sizes, behind it. This general arrangement suggests *Prioniodus* from which *Hindeodella* is distinguished by having an anterior denticulated part with 1 to 8 or 10 small denticles developed in front of the main cusp and in lacking the downwardly projecting spur although this is simulated by the downward deflection of the corresponding part. However this deflected part is bowed horizontally rather than vertically so as to suggest a basketlike expansion at the end of a long bar. The division of the tooth into two denticulated parts suggest a relationship to *Prioniodina* and more particularly to *Euprioniodina* from both of which it is distinguished by the more slender, long and straighter bar and other peculiarities readily apparent on comparing the illustrations of their respective species.

HINDEODELLA SUBTILIS, new species

Plate 8, figs. 17–19

The species is particularly characterized by the minuteness of the denticles and their decided alternation in size, usually three very minute denticles occurring in the space between two that are much longer yet very slender. Base straight with only a moderate downward deflection at the anterior end. Main denticle two or three times as long as those on the bar; in front of it a narrow toothless space and then occurs a group of three or four teeth of which the terminal one is the largest. Specimen represented by figure 18 is supposed to be a variant of the same species.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10985, U.S.N.M.

HINDEODELLA SIMILIS, new species

Plate 8, fig. 20

Similar to *H. subtilis* but the denticles on the bar are all of uniform size without noticeable alternation and the basketlike anterior expansion is of unusual size. At the anterior end the peculiar arrangement of the stronger teeth is shown in the figure.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11299, U.S.N.M.

HINDEODELLA LONGIDENS, new species

Plate 8, figs. 14, 15

General aspect as in the genotype *H. subtilis* but bar somewhat curved with much fewer, stronger, and longer denticles, all of which are of subequal size, well separated from each other of one set only, without alternation. Bar delicate and thin.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10988, U.S.N.M.

HINDEODELLA RECTA, new species

Plate 8, fig. 16

Similar to *H. longidens* but the denticles are all much shorter, the bar straighter and thicker and the anterior projection reduced in length and carrying only a single denticle. The main cusp is also relatively much smaller and shorter.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10984, U.S.N.M.

HINDEODELLA ALTERNATA, new species

Plate 1, figs. 14, 15

In general aspect this tooth reminds considerably of *H. longidens* but is readily distinguishable by its less curved bar, more uniform denticulation and particularly by the presence of one or two shorter and smaller denticles between each pair of the much more conspicuous main set. As the two sets are not exactly aligned, care must be taken not to overlook the smaller set.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11300, U.S.N.M.

HINDEODELLA DECURRENS, new species

Plate 8, fig. 13

Bar curved, the expanded anterior part bent downward and inward and carrying three ridges or ribs rather than prominent denticles. Similar ribs occur behind the main denticle, which is large and strong, and the rest of the bar is occupied by closely set alternately large and long and much shorter minute denticles. This species also suggests departure from the type species toward *Euprioniodina* but after detailed comparison the preponderant alliance seems to favor *Hindeodella.*

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10987, U.S.N.M.

HINDEODELLA SUBEQUALIS, new species

Plate 4, fig. 21

This species suggests a departure from the typical species of the genus towards *Euprioniodina*. This is indicated by the close nonalternating arrangement of the denticles and their more robust character. The anterior end is not sharply deflected as it should be in that genus but retains the essential features of *Hindeodella* though in subdued degree.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Holotype.—Cat. No. 11301, U.S.N.M.

DIPLODODELLA, new genus

Bilaterally symmetrical as in *Hibbardella* but denticles are fused and have minutely bifurcated terminations. The base also is relatively thicker and the sharp-edged major cusp smaller and shorter.

Genotype.—Diplododella bilateralis, new species. Early Mississippian.

DIPLODODELLA BILATERALIS, new species

Text fig. 21 (p. 16)

Specific characters as in the above diagnosis and as shown in figure 21.

Occurrence.—Mississippian (Chattanooga shale): 13 miles east of north of Huntsville, Ala.

Holotype.—Cat. No. 11306, U.S.N.M.

PALMATODELLA, new genus

Though essentially like *Prioniodina* the general aspect is very different, the bar or posterior half being straighter, much longer and slender like a hirsute spine, the anterior end longer, triangular in outline, much wider than the posterior and bent at right angles to it and all denticles much finer, hairlike, sharply directed forward and for the most part fused.

Genotype.—Palmatodella delicatula, new species. Early Mississippian.

PALMATODELLA DELICATULA, new species

Text fig. 20 (p. 16); Plate 10, p. 5

The strikingly palmlike aspect of the species makes it easily recognized. Other features of the species are given in the generic diagnosis.

Occurrence.—Mississippian (Chattanooga shale): 13 miles east of north of Huntsville, Ala.

Holotype.—Cat. No. 11307, U.S.N.M.

SYNPRIONIODINA, new genus

Like *Palmatodella* except that the downturned anterior part is much smaller, bar thicker, denticles not turning forward so sharply and the main cusp proportionately very large. Probably more closely allied to *Euprioniodina* the essential difference being the almost complete lateral fusion of the denticles.

Genotype.—*Synprioniodina alternata*, new species.

Range.—Upper Devonian and Early Mississippian.

SYNPRIONIODINA ALTERNATA, new species

Text fig. 22 (p. 16)

Main cusp large, straight, rounded and directed as much forward as upward. Denticles on bar consisting of two alternating subequal sets, not strongly inclined, laterally fused, numerous, rather short slender, those on the downturned subtriangular anterior part directed forward, about seven in number, all of same width but decreasing regularly in length from above downward.

Occurrence.—Mississippian (Chattanooga shale): 13 miles east of north of Huntsville, Ala.

Holotype.—Cat. No. 11308, U.S.N.M.

Genus LONCHODUS Pander, 1856

Text fig. 16 (p. 16)

The genus *Lonchodus* originally described as *Centrodus* by Pander but changed by him to *Lonchodus* on account of priority is undoubtedly based upon broken incomplete remains of teeth which as our illustrations show might belong to any one of several distinct genera. As it is probable that the true characters of the genus now can not be accurately determined the only use we can suggest for the name is to continue employing it for species based upon similar imperfect and generically indeterminable material.

Genotype.—*Lonchodus* (*Centrodus*) *simplex* Pander, 1856.

Genus CORNURAMIA Smith, 1907

Text figs. 1, 2 (p. 16)

"In this genus there is a double-pointed, hornlike beam" (Smith, 1907).

No American species of this type is known.

Genotypes.—*Cornuramia monodonta* Smith, 1907. Ordovician of Scotland.

Genus PACHYSOMIA Smith, 1907

Text fig. 4 (p. 16)

"Beam thick and curving, one extremity with a knoblike termination, other end sharp" (Smith, 1907). This type of structure has not been found in American strata.

Genotype.—Pachysomia wanlockensis Smith, 1907. Ordovician of Scotland.

Genus VALENTIA Smith, 1907

Text fig. 17 (p. 16)

"From a deep, thin plate a few long slender teeth spring" (Smith, 1907). Based apparently upon a fragmentary specimen.

Genotype.—Valentia morrochensis Smith, 1907. Ordovician of Scotland.

Genus PRIONOGNATHUS Pander, 1856

Text figs. 18, 19 (p. 16)

As our copies of the original illustrations show it is possible that this genus does not belong to the conodonts.

Genotype.—Prionognathus brandtii Pander, 1856. Silurian, Island of Oesel.

Family POLYGNATHIDAE, new family

Plates with a high denticulated median or lateral crest which is often extended stalklike from one end.

Polygnathus (Hinde) Bryant, 1921, *Ancyrodella*, new genus, and *Palmatolepis*, new genus, are referred to this family without question but *Gnathodus* Pander, 1856, *Panderodella*, new genus, and *Ctenognathus* Pander, 1856, are placed here provisionally.

Genus POLYGNATHUS (Hinde) Bryant, 1921

Polygnathus was founded by Hinde upon a group of plates and teeth occurring associated on the same slab of Rhinestreet shale from western New York which he believed to represent the remains of a single animal. In this assemblage no less than five genera as now understood were represented, and it would have been better to have discarded the genus. Since Bryant has redefined the genus and selected a genotype, *P. pennatus*, which he says is represented in Hinde's type assemblage of *P. dubius* in the edge view of the common Genundewa species the genus may be recognized in this restricted sense. Based upon species in accord with the genotype selected by Bryant, *Polygnathus* may be defined as follows:

Plate subsymmetrically lanceolate, traversed by a high median carina extending stalklike from the broader end and reaching, although diminishing gradually in height, to the opposite usually

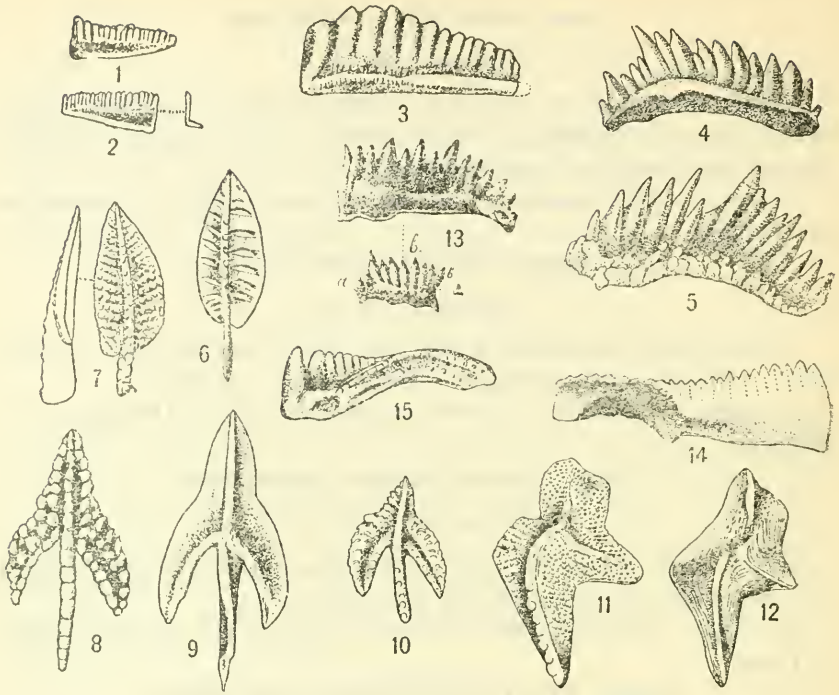

FIG. 5.—POLYGNATHIDAE, NEW FAMILY

1–3. Genus *Panderodella*, new genus. 1, 2. Views of right and left plates with cross section, of the genotype *Panderodella truncata*, new species, × 20. Base of Mississippian (Hardin sandstone), Mount Pleasant, Tenn. 3. Lateral view of *Panderodella suberassa*, new species, × 20, from the same horizon and locality.

4, 5. Genus *Polygnathellus*, new genus. The genotype *Polygnathellus typicalis*, new species, × 20. Upper Devonian (Rhinestreet shale of Portage), Shaleton, N. Y.

6, 7. Genus *Polygnathus* (Hinde) Bryant, 1921. 6. View of upper surface of plate of *Polygnathus pennatus* Hinde, 1879, selected by Bryant as the genotype. Upper Devonian (Genundewa limestone of Genesee), Eighteen Mile Creek, N. Y. 7. Upper and side views of plate of *Polygnathus pennatulus* new species, × 20, a similar species from the base of Mississippian (Hardin sandstone), Mount Pleasant, Tenn.

8–10. Genus *Ancyrodella*, new genus. 8, 9. Upper and lower surfaces of the genotype *Ancyrodella nodosa*, new species, × 20. Devonian (Rhinestreet), Shaleton, N. Y. 10. Upper surface of *Ancyrodella hamatus*, new species, × 20, Hardin sandstone, Mount Pleasant, Tenn.

11, 12. Genus *Palmatolepis*, new genus. Upper and lower surface of the genotype *Palmatolepis perlobata*, new species. Hardin sandstone, Mount Pleasant, Tenn.

13. Genus *Ctenognathus* Pander, 1856. Views of the genotype *Ctenognathus murchisoni* Pander, 1856. Silurian. Island of Oesel.

14. Genus *Gnathodus* Pander, 1956. Pander's illustration of the genotype *Gnathodus mosquensis* Pander, 1956. Carboniferous of Russia. 15. Side view of a plate of *Polygnathus* from Hardin sandstone at Mount Pleasant, Tenn., showing resemblance to *Gnathodus*.

pointed end, dividing the plate into two lateral, subequal areas. The carina is also indicated by a corresponding ridge on the underside. On the upper surface the summit of the carina carries a row of closely approximated nodes and the depressed sides of the plate are variously ornamented with nodose ridges. The underside is smooth or with fine concentric lines.

POLYGNATHUS RIMULATUS, new species

Plate 1, figs. 8, 9

This is a much smaller species than the genotype *P. pennatus*, which it resembles in general aspect but differs structurally in the fact that the edge of the lanceolate plate is definitely raised in a continuous minutely nodose rim. The depressed spaces between this rim and the central crest are also smaller and on the whole give much less the appearance of outwardly enlarging rows of nodes characterizing that species.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11302, U.S.N.M.

POLYGNATHUS PENNATULUS, new species

Plate 7, fig. 8; Plate 9, figs. 24, 25

Our views illustrate the top, profile, and cross section showing crest and concave lateral areas with margins elevated nearly to level of crest. The outline is lanceolate, although not quite equilateral, but the species is distinguished from others of similar form by the surface markings, the crest having a double row of tubercles and the lateral areas covered by pinnately arranged similar tubercles.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10996, U.S.N.M.

POLYGNATHUS DELICATULUS, new species

Plate 7, figs. 9, 10

Closely related to *P. pennatulus* but markings more delicate and arranged more transversely. These markings take the form of numerous parallel striations arranged nearly at right angles to the prominent median crest.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10994, U.S.N.M.

POLYGNATHUS FOLIUM, new species

Plate 7, fig. 5

Crest simple with parallel vein-like striations crossing the flattish lateral areas.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11012, U.S.N.M.

POLYGNATHUS RHOMBOIDEUS, new species

Plate 7, fig. 6

Our figure shows the upper side of plate illustrating rather regularly rhombic outline and coarse longitudinally arranged tubercles of the lateral areas with a row of similar tubercles on the posterior third of the crest.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11013, U.S.N.M.

POLYGNATHUS GERMANUS, new species

Plate 7, figs. 11, 12

Related to *P. rhomboideus*, but has a more regularly lanceolate outline and lacks the tubercles on the crest.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 10997, U.S.N.M.

POLYGNATHUS GLABER, new species

Plate 7, fig. 13

A lanceolate species doubtless allied to *P. peracutus* Bryant from the Genundewa limestone (Devonian) of New York, but differing conspicuously from it in its smooth instead of coarsely tuberculated surface.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11004, U.S.N.M.

POLYGNATHUS CONFLUENS, new species

Plate 7, figs. 14, 15

This new species belongs to the typical (lanceolate) group but is readily distinguished by the confluence and somewhat concentric

arrangement of the series of surface nodes. The crest is apparently without nodes.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10998, U.S.N.M.

POLYGNATHUS SUBLATUS, new species

Plate 8, fig. 2

Quite similar to *P. pennatulus* except that the whole form is broader, the lateral area flatter, the mid-rib does not reach the anterior extremity, and the rows of tubercles have a tendency to radial arrangement.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11009, U.S.N.M.

POLYGNATHUS? ACAULIS, new species

Plate 8, figs. 4, 5

Our illustrations of the upper and lower surfaces of two plates show the characteristic triangular outline and absence of stalklike projection of the median crest. Hinde gives poor figures of two specimens named *P. truncatus*, which must be related to this species. These are also of triangular form and lack the stalk. Even the median crest is not represented on the larger of the two which moreover comes from a very different geological horizon. Until specimens of Hinde's species are found, fuller comparisons are not possible. The present species differs from all others and must be considered a doubtful form of the genus.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11003, U.S.N.M.

POLYGNATHUS CONCENTRICUS, new species

Plate 8, figs. 6, 7

We figure the upper and lower surfaces of two plates, the former showing the highly ornamental concentric arrangement of the surface tubercles reminding of *P. confluens* but the specimens are larger and the outline is less regularly lanceolate.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11002, U.S.N.M.

POLYGNATHUS CRASSULUS, new species

Plate 8, figs. 8–10

Lower (8) and top (10) views of the same specimen with figure 9, representing a three-quarters basal and edge view. The outline and markings tend to be irregular although the lanceolate form is maintained. The crest runs through on both surfaces although very high in posterior part of upper side. Anterior half of upper surface irregularly tuberculated and posterior half irregularly plicated. Lower surface with concentric lines and undulations.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11001, U.S.N.M.

ANCYRODELLA, new genus

Similar to *Polygnathus* but the depressed lateral areas are drawn out at the wider end so as to give the whole plate an anchor like outline.

Genotype.—*Ancyrodella nodosa*, new species.

Range.—Upper Devonian and lower Mississippian.

ANCYRODELLA NODOSA, new species

Plate 1, figs. 10–13

Plate anchor or somewhat harpoon shaped, essentially bilateral in form with a central crest prolonged posteriorily into the free shaft like extension, and rather narrow posteriorily, widely diverging but finally incurving, flukelike lateral limbs. The median crest and also the median lines of the flukes are made by a series of basally connected strong nodes and a similar row of nodes form an elevated edge around the whole fluke.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11303, U.S.N.M.

ANCYRODELLA HAMATA, new species

Plate 7, fig. 7

Readily distinguished from the genotype by lacking the row of nodes on the lateral appendages. As in that species the shape simulates the head of a harpoon. The shaft passes into a median crest extending to the anterior extremity with the marginal portions throughout, coarsely tuberculate.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11011, U.S.N.M.

ANCYRODELLA SYMMETRICA, new species

Plate 8, fig. 1

Evidently a lineal descendant of *A.* (*Polygnathus*) *tuberculata* Hinde from the Genundewa limestone of western New York. These species differ, however, conspicuously in that *A. symmetrica* lacks entirely the coarse tubercules. Among other differences, the flukelike extensions are not definitelly separated from the anterior part. Again the anterior part of the plate has developed a pair of posteriorily diverging low ridges.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11008, U.S.N.M.

ANCYRODELLA MALLEUS, new species

Plate 7, figs. 1, 2

Differs from *A. symmetrica* in the unsymmetrical hammerlike shape which is produced by the reduction or truncation of the anterior part of plate but resembling it in its bifurcated recurved crest and lack of surface tubercles.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11006, U.S.N.M.

PALMATOLEPIS, new genus

Plate more or less irregularly palmate, the crest curved and bifurcating in its upper half so as to extend a division into each of the two main lobes and its lower end not extending beyond the narrowing lateral areas. Upper surface highly ornamented, usually with radially or otherwise arranged rows of minute tubercles. Under surface with concentric growth lines and low ridges corresponding to the bifurcated crest of the upper surface.

Genotype.—Palmatolepis perlobata, new species.

Range.—Upper Devonian and Lower Mississippian.

PALMATOLEPIS PERLOBATA, new species

Plate 7, figs. 19–23

Five specimens are figured, two lower (19, 21) and two upper (20, 22) showing the tendency to obsolescence of the lateral branch of the median crest, the irregular although decidedly lobate outline and the decided curvature of the crest. Figure 23 represents a more triangular possible variant of this species.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotype.—Cat. No. 10995, U.S.N.M.

PALMATOLEPIS BIFURCATA, new species

Plate 7, figs. 16, 17

Lower and upper surface of two examples showing the distinct and characteristic subequal bifurcation of the median crest. Upper surface strongly tuberculated without definite arrangement; under surface concentrically striated and ridged similar to the upper surface.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11010, U.S.N.M.

PALMATOLEPIS ASYMMETRICA, new species

Plate 7, fig. 18

A member of the bifurcata group but readily distinguished by the extreme divergence of the bifurcation, by the unsymmetrical arrangement of its parts and the irregularly triangular outline.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Holotype.—Cat. No. 11000, U.S.N.M.

PALMATOLEPIS EXTRALOBATA, new species

Plate 8, fig. 3

Founded on a single specimen showing the under side. Similar to *P. perlobata* and possibly a variant of it but differing in the presence of an extra fan-shaped lobe along the anterior side and the sharp angle of divergence to the right of both branches of the crest.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Holotype.—Cat. No. 11007, U.S.N.M.

PALMATOLEPIS LOBATULA, new species

Plate 7, figs. 3, 4

Distinguished by the lobate outline, peculiarly curved crest bifurcating anteriorly, one of the branches running off at right angles to the top of the lateral lobe and by the finely lineate ornament present everywhere except on the denticulated summit of the posterior half of the main crest.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11005, U.S.N.M.

PALMATOLEPIS PECULIARIS, new species

Plate 8, figs. 11, 12

Our illustrations are of the upper surface of opposite plates, one with peculiar anterior process which if normal has been lost on the other specimen. Species distinguished by complete or partial obsolescence of the forks of the carina and the general peculiar shape. Surface finely granulose, the granules being usually arranged in neat lines running from the median crest to the outer edges. Large node at upper extremity of crest and a row of smaller ones extending nearly to the posterior extremity. The relations of the species seem to be with *P. extralobata* the anterior process being correlated with the extra lobe in that species.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 10999, U.S.N.M.

PALMATOLEPIS GLABER, new species

Plate 9, figs. 18–20

Distinguished from other species of this genus by the unusual narrowness of the plate as a whole and by the exceeding minuteness of the surface markings. The latter consist of very fine inosculating lines barely distinguishable under a 20-diameter enlargement. There is a distinct trace of the bifurcation, but the lateral lobe is practically obsolete, although the prolongation at the knob is indicated. The crest dies out before reaching the anterior extremity, but is prominent and strong in the middle and posterior parts.

Occurrence.—Mississippian (Hardin sandstone) : Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11043, U.S.N.M.

PALMATOLEPIS PUNCTATA Hinde, 1879

Plate 1, figs. 6, 7

1879. *Polygnathus punctatus* HINDE, Quart. Journ. Geol. Soc. London, vol. 35, p. 367, pl. 17, fig. 14.

Although named *Polygnathus punctatus* by Hinde, his description very definitely says, "Surface of plate is covered by very minute tubercles." Both the original description and figure are indefinite as to the details of form and marking of plate, and in one feature they depart from the description, but we still have little hesitancy

in identifying the specimens figured on plate 1 with Hinde's species. Our specimens, of which there are many and all surprisingly alike, differ from Hinde's description and figure in that the carina, although becoming very thin, is nevertheless distinguishable quite to the edge of the plate. This feature is even better indicated on the lower side. The arrangement of the surface tuberculation indicates a rather decided radial arrangement of the rows of tubercles, which in certain lights appear like simple raised lines. The carina of the branch to the lateral lobe leaves the main crest at approximately right angles. It is thin in its inner part, but the branch thickens toward the margin of the plate.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Plesiotypes.—Cat. No. 11309, U.S.N.M.

PANDERODELLA, new genus

Platelike structures consisting mainly of a high but thin pectinated crest with a broad basal expansion (plate proper) developed on one side of crest only and extending its full length.

This genus comprises a series of structures trending toward the leaflike *Polygnathus* plates but differing in that the pectinated crest is the major part of the structure and the basal expansion or plate proper is developed only on one side. The crest is highest at one end, presumably the posterior one. It differs again in that the lateral area extends the full length of the crest. The cross section of the plate and crest is therefore L-shaped. The basal expansion is smooth. The denticles of the crest are joined, becoming free only at their tips.

Genotype.—*Panderodella truncata*, new species.

Range.—Upper Devonian and Early Mississippian.

Although we provisionally assign this genus to the Polygnathidæ, the fact that several species show a protuberance near the middle of the unflanged side, a feature common in many typical conodonts, makes it possible that the genus does not represent a dermal plate.

Polygnathus scitulus Hinde and *P. solidus* Hinde apparently belong to this genus.

PANDERODELLA TRUNCATA, new species

Plate 9, figs. 15–17

Plate as a whole characterized by rectangular broader end tapering slowly to a point of less than half the height at the other end and by the rather narrow and not sharply bowed over basal flange and small regular subequal denticles laterally in contact.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11040, U.S.N.M.

PANDERODELLA SUBCRASSA, new species

Plate 9, fig. 14

Similar to *P. truncata* but much larger and with relatively much coarser denticles, shorter form, thicker flange, and somewhat curved crest. The denticles decrease in size from the broader end.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Holotype.—Cat. No. 11042, U.S.N.M.

PANDERODELLA MAXILLARIS, new species

Plate 9, fig. 21

Characterized by the great thickening of the anterior part of the jawlike plate and the swelling just under the denticles. The flange is only of moderate width.

Occurrence.—Mississippian (Hardin sandstone): Mount Pleasant, Tenn.

Cotypes.—Cat. No. 11041, U.S.N.M.

POLYGNATHELLUS, new genus

Similar to *Panderodella* with a curved crest made up of joined, mostly sharp-edged denticles, longest in the middle and shortening towards the two ends. On the convex side there is a very narrow, smooth basal expansion, while on the concave side occurs a wider flange, the upper surface of which is tuberculated as in *Polygnathus*. In side view the plate, especially the crest, reminds of *Bryantodus*, but the development of the concave tuberculated basal expansion on one side is quite different and causes us to believe the generic relations are more with *Polygnathus*.

Genotype.—*Polygnathellus typicalis*, new species.

Range.—Upper Devonian, Early Mississippian.

Besides the two species herein described, *Prioniodus colligatus* Bryant, 1921, appears to have the characters of this genus.

POLYGNATHELLUS TYPICALIS, new species

Plate 1, figs. 1–3

Our views illustrating the two sides and the bottom of the plate bring out the features discussed above in the generic diagnosis as based upon this the type species.

Occurrence.—Devonian (Rhinestreet): Shaleton, N. Y.

Cotypes.—Cat. No. 11304, U.S.N.M.

POLYGNATHELLUS CURVATUS, new species

Plate 1, fig. 4

The specimen of which the impression of the concave side is shown in Figure 4 is supposed to represent a distinct species, differing from the genotype in the much greater curvature of the plate as seen in lateral view. The basal expansion is narrower and its surface is not so distinctly tuberculated. In other respects the two species are essentially the same.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Holotype.—Cat. No. 11305, U.S.N.M.

Genus GNATHODUS Pander, 1856

After much speculation as to what *Gnathodus* may really be, we must admit failure to reach a satisfactory conclusion. All the specimens we first believed to belong here have proved to be side views of species of *Polygnathus*. It is possible that Pander's figure of *Gnathodus mosquensis* may also be such a side view with the crest showing the height of the posterior extension of the crest and the plate crumpled or broken away. Bryant believed that the genus might be retained and placed here an American Devonian species in which the flanges of the plates are very little developed. This may be true but we have seen no specimen which conclusively establishes this view. For the present we must leave *Gnathodus* out of consideration in describing American conodonts.

?GNATHODUS, species

Plate 1, fig. 5

We have illustrated an example with the kind of appearance that we had supposed might be referable to *Gnathodus* if that should really prove to be a distinct genus. On further more careful examination of this and similar specimens we were forced to the conclusion that they represent merely side views of *Polygnathus* forms with the crest shown in its full height and the expansions making the plate broken.

Occurrence.—Devonian (Rhinestreet) : Shaleton, N. Y.

Genus CTENOGNATHUS Pander, 1856

Considering *C. murchisoni* as the genotype, this genus is of very doubtful relations and may not be a true conodont at all. The figures of the second species *C. verneuilli* suggest at least three generic types, while the last species *C. keyserlingi* shows no characters definitely recognizable among any of our forms. Under these circumstances *Ctenognathus* must be provisionally set aside as insufficiently established.

EXPLANATION OF PLATES

PLATE 1

All the illustrations on this plate are magnified 15 diameters and the specimens are from the Rhinestreet shale of the Portage group at Shaleton, Erie County, N. Y.

Page

FIG. 1–3. *Polygnathellus typicalis*, new species 53
(1) Side view of plate exhibiting curved crest of joined denticles and tuberculated concave side.
(2) Upper side of basal plate.
(3) View exhibiting convex side of basal expansion.

4. *Polygnathellus curvatus*, new species 54
The type specimen, the impression of the concave side.

5. *?Gnathodus*, species 54
Specimen ordinarily referred to *Gnathodus* but which is believed to be a side view of an imperfectly preserved *Polygnathus*.

6, 6′, 7. *Palmatolepis punctata* Hinde, 1879 51
Upper surface of two plates, right and left, and under surface of a third.

8, 9. *Polygnathus rimulatus*, new species 45
Upper surfaces of two examples of this minute species.

10–13. *Ancyrodella nodosa*, new species 48
Upper and lower surfaces of plates showing slight variations.

14, 15. *Hindeodella alternata*, new species 40
Outer sides of two teeth; in 14 the minute denticles are little visible, due to orientation of specimen in rock.

16, 17. *Prioniodus curvidens*, new species 11
Two teeth, left and right, illustrating slight forward curvature of denticles.

18–20. *Prioniodus undosus*, new species 12
Three teeth exhibiting the downward curvature of the bar.

21. *Euprioniodina bryanti*, new species (see also pl. 3, figs. 13, 14) 29
An example resembling a *Ligonodina*, but the downward projection is provided with small denticles.

22. *Prioniodus proclinatus*, new species 10
The type specimen showing the large, anteriorly inclined terminal cusp.

23. *Prioniodus inutilis*, new species 11
Tooth with main cusp and denticles rather widely separated.

24. *Lonchodina subsymmetrica*, new species (see also pl. 6, figs. 5–7; pl. 5, fig. 8) 34
A broken specimen preserving only the main cusp and part of bar, showing possibility of identification with *Prioniodus*.

25, 26. *Prioniodus alatus* Hinde, 1879 11
Two examples of this fine large species.

PLATE 2

Illustrations all magnified 15 diameters and specimens are from the Rhinestreet shale of the Portage group at Shaleton, Erie County, N. Y.

Page

FIG. 1, 2. *Ligonodina panderi* Hinde, 1879 ---------- 13
(1) Pander's drawnig of his type.
(2) A young specimen referred to the species.

3, 4. *Ligonodina deflecta*, new species ---------- 13
Two teeth, representing outer and inner sides, showing the characteristic curvature of the base in the posterior half.

5, 6. *Ligonodina magnidens*, new species ---------- 14
Teeth of opposite sides exhibiting the large size of the denticles.

7, 8. *Ligonodina hibbardi*, new species ---------- 14
A young and a mature example, opposite sides.

9, 10. *Ligonodina pectinata*, new species ---------- 13
Two examples, the first nearly complete, illustrating the comb-like arrangement of the denticles.

11–13. *Ligonodina falciformis*, new species ---------- 14
(11, 12) Two fairly complete teeth showing the backward slant of the denticles.
(13) Another example in which the carina of the main cusp and the suckerlike protuberances of its downward extension are well shown.

14–16. *Ligonodina hindei*, new species ---------- 14
(14) An incomplete example preserving well developed downward extension.
(15, 16) Two specimens illustrating the same side but right and left, showing relationship to *L. panderi* but differing in the recurving of the main cusp and denticles.

PLATE 3

Specimens here illustrated are from the Rhinestreet shale at Shaleton, N. Y., and illustrations are magnified 15 diameters.

Page

FIG. 1–4. *Hibbardella angulata* Hinde, 1879 ---------- 37
(1, 2) Two examples regarded as typical.
(3) A variety with the main cusp broad, more sharp edged and relatively shorter than others.
(4) A specimen illustrating length of medium cusp of this or a similar species.

5. *Hibbardella? confertissima*, new species ---------- 38
The type specimen of this minute species.

6, 7. *Hibbardella subequalis*, new species ---------- 38
Two specimens, one (7) a mold in the rock, illustrating the short main cusp and the thick bar.

8, 9. *Hibbardella multidens*, new species ---------- 38
Two examples showing the wide angle made by the two ends of bar and the numerous denticles.

10. *Euprioniodina perangulata*, new species ---------- 30
The holotype showing great development of the downward projection.

Page

FIG. 11, 12. *Euprioniodina deflecta*, new species 29
The type specimen with the downward extension well preserved.

13, 14. *Euprioniodina bryanti*, new species (see also pl. 1, fig. 21) .. 29
Same side of two teeth. The downward extension makes less than a right angle with the bar.

15, 16. *Lonchodina increbescens*, new species (see also pl. 5, fig. 20) 35
Two imperfect examples showing resemblance to *Euprioniodina*.

17. *Euprioniodina conferta*, new species 29
Tooth showing short downward projection and the flat, wide main cusp.

PLATE 4

Specimens here illustrated are from the Rhinestreet shale at Shaleton, Erie County, N. Y., and illustrations are magnified 15 diameters.

Page

FIG. 1, 1′. *Prioniodella normalis*, new species 19
Two views of the type, with the light coming from opposite directions.

2, 3. *Prioniodella inaequalis*, new species 19
View of the holotype (2) and of a smaller example.

4, 5. *Prioniodella multidens*, new species 19
The type example of this minute species, × 15 and × 20.

6, 7. *Prioniodella acquidens*, new species 19
Two views of the type with different lighting.

8, 9. *Bryantodus conjunctus*, new species 24
Two teeth showing opposite sides. The strong curvature of the bar is marked.

10, 11. *Bryantodus transitans*, new species 26
Two examples illustrating resemblance to *Prioniodella*.

12–14. *Bryantodus nitidus* new species 24
Teeth of this neat species, the third (14) referred here doubtfully.

15. *Lonchodina geniculata*, new species 36
The type of the species, readily recognized by the sharply bent bar.

16. *Bryantodus semiseparatus*, new species 24
The holotype, characterized by the slender main cusp and strongly curved bar.

17, 18. *Prioniodina separata*, new species 18
Two specimens exhibiting the main cusp more median in position and smaller than in *P. subcurvata*.

19, 20. *Bryantodus curvatus*, new species 26
The type specimen showing resemblance to *Prioniodina*.

21. *Hindeodella subequalis*, new species 41
Outer sides of two teeth.

22–24. *Prioniodina subcurvata*, new species 18
Views showing the generic characters, discrete denticles on each side of main cusp.

Page

FIG. 25–27. *Bryantodus normalis*, new species ---------- 24
Three teeth showing different aspects of the species.

28. *Bryantodus coalescens*, new species ---------- 25
The type specimens showing the merging of four or five denticles adjacent to the main cusp.

PLATE 5

Specimens here illustrated are from the Rhinestreet shale at Shaleton, N. Y., and the illustrations are magnified 15 diameters.

Page

FIG. 1, 2. *Lonchodina typicalis*, new species ---------- 31
(1) An imperfect large example.
(2) A perfect smaller specimen.

3. *Lonchodina subangulata*, new species ---------- 32
The holotype showing the straight, backward bent main cusp.

4, 5. *Lonchodina subrecta*, new species ---------- 33
Two teeth exhibting the similarity in size of the main cusp and several of the denticles.

6, 7. *Lonchodina perlonga*, new species ---------- 32
Teeth with long, slender, slightly curved denticles, characterizing the species.

8. *Lonchodina subsymmetrica*, new species (see also pl. 6, figs. 5–7, and pl. 1, fig. 24) ---------- 34
Tooth similar to that in *L. perlonga*, but denticles and main cusp are shorter.

9, 10. *Lonchodina? projecta*, new species ---------- 35
Two teeth, one imperfect, but both showing the short posterior end.

11. *Lonchodina delicatula*, new species ---------- 33
The holotype of the species, easily recognized by the widely separated denticles.

12. *Lonchodina separata*, new species ---------- 31
Type, differing from *L. delicatula* in shorter tooth with fewer denticles.

13, 14. *Lonchodina rectidens*, new species ---------- 31
Two teeth upon which the species is based, illustrating the four large median denticles.

15. *Lonchodina arcuata*, new species ---------- 32
The holotype of this strongly curved species.

16, 17. *Lonchodina prona*, new species ---------- 36
Views of two specimens illustrating opposite sides.

18. *Lonchodina bilateralis*, new species ---------- 32
View of the holotype showing the two large denticles.

19. *Lonchodina perarcuata*, new species ---------- 33
The type specimen illustrating the horseshoe-shaped bar.

20. *Lonchodina increbescens*, new species (see also pl. 3, figs. 15, 16) ---------- 35
A specimen preserving the anterior part showing resemblance to *Euprioniodina*.

PLATE 6

Specimens here illustrated are from the Rhinestreet shale at Shaleton, N. Y., and the illustrations are magnified 15 diameters.

Page

FIG. 1. *Lonchodina paucidens*, new species 34
Tooth with the few straggly, slender denticles on a curved bar, characteristic of the species.

2, 3. *Lonchodina transversa*, new species 34
Two examples showing range in size but both illustrating the characteristic long, straight, outwardly bowed bar.

4. *Lonchodina alternata*, new species 35
The holotype illustrating alternation of large and small sets of denticles.

5–7. *Lonchodina subsymmetrica*, new species (see also pl. 5, fig. 8 and pl. 1, fig. 24 34
Three of the cotypes showing specimens of various sizes.

8–10. *Lonchodina abnormis*, new species 34
Three teeth with the characteristic short, thick bar surmounted by few well-separated denticles.

11, 12. *Bryantodus typicus*, new species 21
Examples of different sizes illustrating the broad cusp laterally confluent with the adjacent denticles.

13. *Bryantodus tridentatus*, new species 22
The holotype, consisting of three broad-based, thin-edged denticles.

14. *Bryantodus inequalis*, new species 22
Tooth showing the unequal development of denticles on the sides of the main cusp.

15, 16. *Bryantodus multidens*, new species 22
Two teeth showing opposite sides.

17, 18. *Bryantodus crassidens*, new species 23
Opposite sides of two teeth showing the short, thick denticles.

19–21. *Bryantodus obliquus*, new species 23
Three teeth of different sizes illustrating the anteriorily curved denticles.

22–24. *Bryantodus sinuatus*, new species 23
Specimens showing the characteristic sinuate base.

PLATE 7

The specimens here illustrated are from the Hardin sandstone basal member of the Mississippian-Chattanooga black shale at Mount Pleasant, Tenn. Magnification, × 15.

Page

FIG. 1, 2. *Ancyrodella malleus*, new species 49
Concave under surface (1) and upper surface (2) of the type specimen.

3, 4. *Palmatolepis lobatula*, new species 50
Upper surface of the type specimen (3) and under surface of another plate referred to the species.

Page

FIG. 5. *Polygnathus folium*, new species 46
Upper surface of plate, showing irregular leaf-shaped outline.
6. *Polygnathus rhomboideus*, new species 46
Upper side of plate exhibiting rhombic outline.
7. *Ancyrodella hamata*, new species 48
Upper surface of the harpoon shaped plate.
8. *Polygnathus pennatulus*, new species. (See also pl. 9, figs. 24, 25) .. 45
Profile, top view and cross section of the type specimen.
9, 10. *Polygnathus delicatulus*, new species 45
Upper surface of two examples.
11, 12. *Polygnathus germanus*, new species 46
Top and edge views of the type specimen.
13. *Polygnathus glaber*, new species 46
Top of plate showing smooth surface.
14, 15. *Polygnathus confluens*, new species 46
Upper and lower surfaces of two examples.
16, 17. *Palmatolepis bifurcata*, new species 50
Lower and upper surfaces of separate specimens.
18. *Palmatolepis asymmetrica*, new species 50
Upper surface of this unsymmetrical plate.
19–23. *Palmatolepis perlobata*, new species 49
Five specimens—two (19, 21) showing lower surface, two (20, 22) the upper surface, and one (23) representing possibly a variation.

PLATE 8

All the illustrations on this plate are magnified 15 diameters. The specimens are from the Hardin sandstone basal member of the Mississippian-Chattanooga black shale at Mount Pleasant, Tenn.

Page

FIG. 1. *Ancyrodella symmetrica*, new species 49
Upper surface showing symmetrical arrangement of ornament.
2. *Polygnathus sublatus*, new species 47
Upper surface illustrating arrangement of tubercular ornament.
3. *Palmatolepis extralobata*, new species 51
Under surface of the type specimen.
4, 5. *Polygnathus acaulis*, new species 47
Upper and lower surfaces of two plates exhibiting absence of stalklike projection.
6, 7. *Polygnathus concentricus*, new species 47
Upper and lower surfaces of two plates showing the ornamentation.
8–10. *Polygnathus crassulus*, new species 48
Lower, edge, and top views of the same specimen.
11, 12. *Palmatolepis peculiaris*, new species 51
Upper surface of opposite plates.
13. *Hindeodella decurrens*, new species 40
The type specimen showing the characteristic downward curving of the anterior portion.

Page

FIG. 14, 15. *Hindeodella longidens*, new species 40
Two examples exhibiting the rather few but long denticles.

16. *Hindeodella recta*, new species 40
Tooth showing similarity to *H. longidens* but denticles are all shorter.

17–19. *Hindeodella subtilis*, new species 39
Two teeth viewed from opposite sides (17, 19) and another specimen (18) believed to be a variation of the species.

20. *Hindeodella similis*, new species 39
Tooth with relationship to *H. subtilis* but denticles are of uniform size.

PLATE 9

The illustrations on this plate are magnified 15 diameters, and the specimens are from the Hardin sandstone basal member of the Mississippian-Chattanooga black shale at Mount Pleasant, Tenn.

Page

FIG. 1. *Prioniodus parvidentatus*, new species 9
Tooth showing minute, closely arranged denticles.

2, 3. *Prioniodus spicatulus*, new species 9
Right and left teeth with the widely separated minute denticles.

4. *Prioniodus reversus*, new species 10
An imperfect specimen.

5. *Ligonodina tridentata*, new species 15
View of tooth showing the peculiarities of this species.

6. *Prioniodus inequalis*, new species 10
Tooth with the characteristic unequal development of the two parts of the main cusp.

7. *Prioniodus cultratus*, new species 9
An imperfect tooth exhibiting the erect denticles.

8–10. *Prioniodus proclinis*, new species 9
Three teeth of which Figure 8 represents the holotype.

11. *Prioniodus concavus*, new species 10
Tooth exhibiting the well-developed concave base.

12. *Prioniodus disparilis*, new species 10
The type specimen with its very large and rounded terminal cusp.

13. *Bryantodus curvatulus*, new species 28
Tooth with the characteristic curved bar and compactly arranged denticles.

14. *Panderodella subcrassa*, new species 53
View of plate showing the coarse denticles.

15–17. *Panderodella truncata*, new species 52
(15, 16) Right and left plates with cross section of one, and (17) a longer example.

18–20. *Palmatolepis glaber*, new species 51
(18, 19) Side views of two plates and cross section, illustrating the sharply defined, broad base, and (20) side view of another plate.

Page

FIG. 21. *Panderodella maxillaris*, new species 53
The type of the species, a left plate, showing the thick anterior end.
22. *Distacodus rectus*, new species 6
View of type, a nearly straight elongate tooth flaring at the base.
23. *Polygnathus*, species 43
Side view of plate.
24, 25. *Polygnathus pennatulus*, new species (see also pl. 7, fig. 8) ... 45
Side views of right and left plates.
26, 27. *Polygnathus*, species 43
Side view of plates of two undetermined species.
28. *Ligonodina simplex*, new species 15
The type specimen showing the bar without denticles and the recurved cusp.

PLATE 10

All the illustrations on this plate are magnified 15 diameters. The specimens are from the Hardin sandstone basal member of the Mississippian-Chattanooga black shale at Mount Pleasant, Tenn.

Page

FIG. 1, 2. *Lonchodina discreta, new species* 36
A young example (1) and a larger tooth (2) showing the curvature of base and widely separated denticles.
3. *Euprioniodina peculiaris*, new species 30
View of this large species.
4. *Lonchodina rectangulata*, new species 37
The strongly curved tooth with small median denticles.
5. *Palmatodella delicatula*, new species 41
Portion of an imperfect specimen.
6. *Bryantodus minutus*, new species 27
Tooth of this minute species with large median cusp.
7. *Bryantodus tenuis*, new species 26
View of the very slender tooth with closely arranged denticles.
8. *Bryantodus incertus*, new species 27
Tooth of this large species.
9. *Bryantodus nelsoni*, new species 28
Tooth showing resemblance to *Hindeodella*.
10. *Bryantodus gracilis*, new species 27
View of the type illustrating similarity to *B. subradiatus*.
11. *Bryantodus pergracilis*, new species 27
Tooth of this slender species with rather straight base.
12, 13. *Bryantodus subradiatus*, new species 26
Right and left teeth.
14. *Bryantodus crassus*, new species 27
The type specimen, a broken tooth.
15, 16. *Bryantodus subbrevis*, new species 28
Opposite teeth exhibiting the characteristic short form and semiovate outline.
17. *Bryantodus insolens*, new species 25
Specimen showing the prominent median cusp and unequal arrangement of denticles.

Page

FIG. 18. *Bryantodus germanus*, new species 25
View of the type showing relationship to *B. insolens*.

19, 20. *Prioniodella informata*, new species 20
Two teeth showing denticles increasing in length toward middle.

21. *Prioniodella brevispina*, new species 20
Tooth showing characteristic thick bar and short length of denticles.

22, 23. *Prioniodella gracilis*, new species 20
Two teeth exhibiting the denticles directed obliquely backward.

24. *Prioniodella robusta*, new species 20
Tooth showing large erect denticles and absence of spur.

25. *Prioniodella conferta*, new species 21
View of tooth illustrating closely arranged, obliquely set denticles.

PLATE 11

1. Jaw, × 2.5, of small selachian from Sandwich Islands, showing teeth and dermal plates.
2. Teeth of same, × 6, illustrating median denticles and basal prong for attachment in jaw, similar to conodonts.
3. Dermal plates of the same specimen, × 20.
4, 5. Portion of jaw of a recent shark, × 2.5 and × 6, exhibiting arrangement of teeth and their similarity to conodont genera like *Bryantodus*. The little variation in the shape of the teeth is also apparent.
6. Outer and inner sides of jaw of a recent myxine fish (*Myxine glutinosa*) from Stonington, Conn., with an isolated tooth, showing resemblances to such conodonts as *Distacodus*.
7. Dermal plates of the recent shark *Eulamia obtusa*, × 20.
8. Skin of another recent shark *Platypodon*, × 20, with small closely arranged dermal plates.

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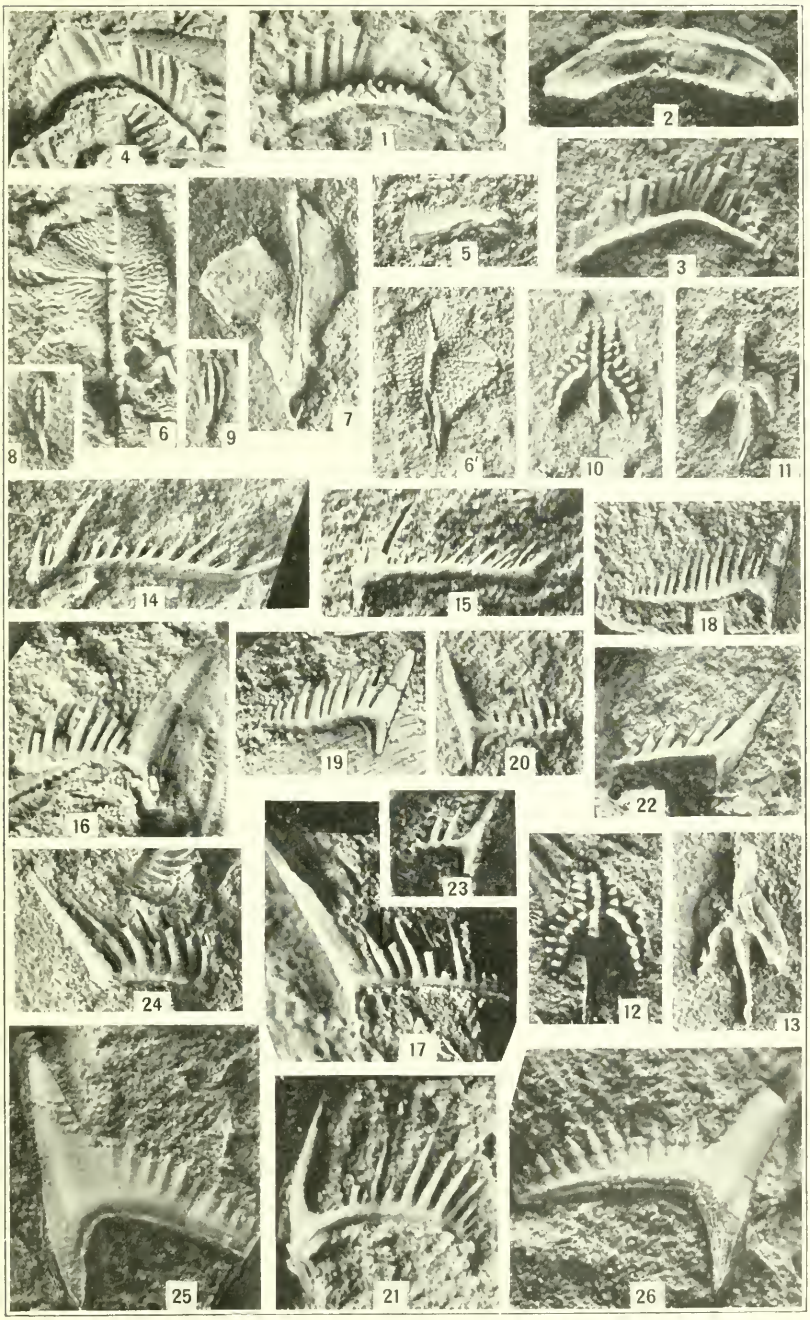

AMERICAN DEVONIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 55

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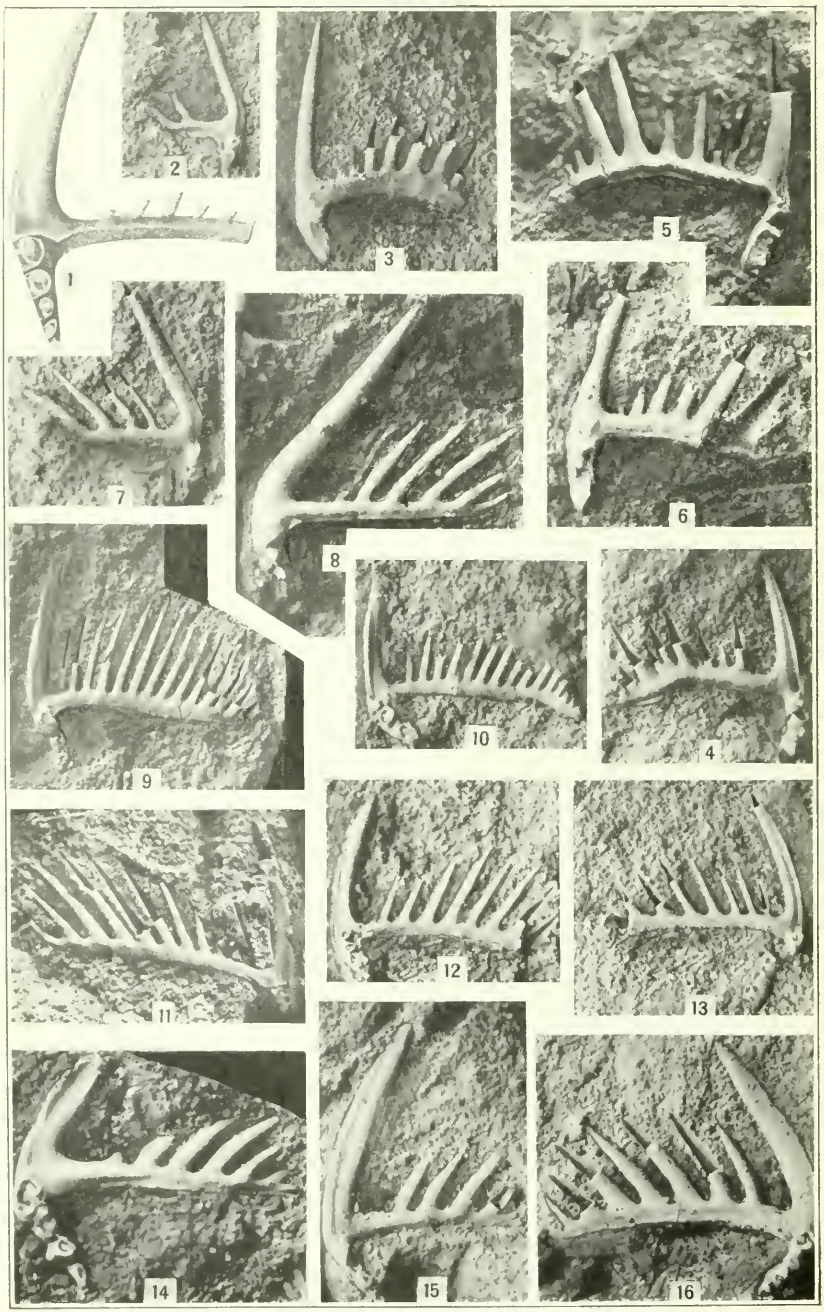
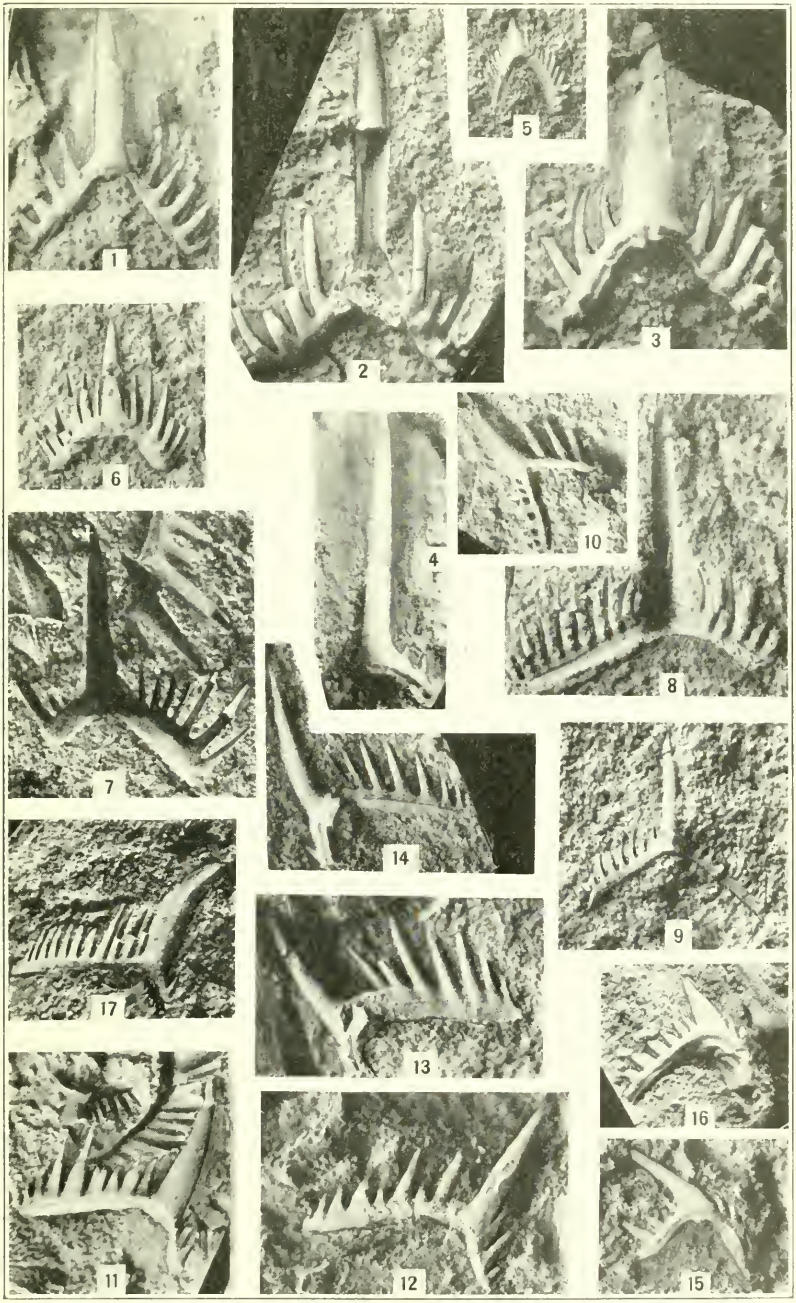


AMERICAN DEVONIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 56

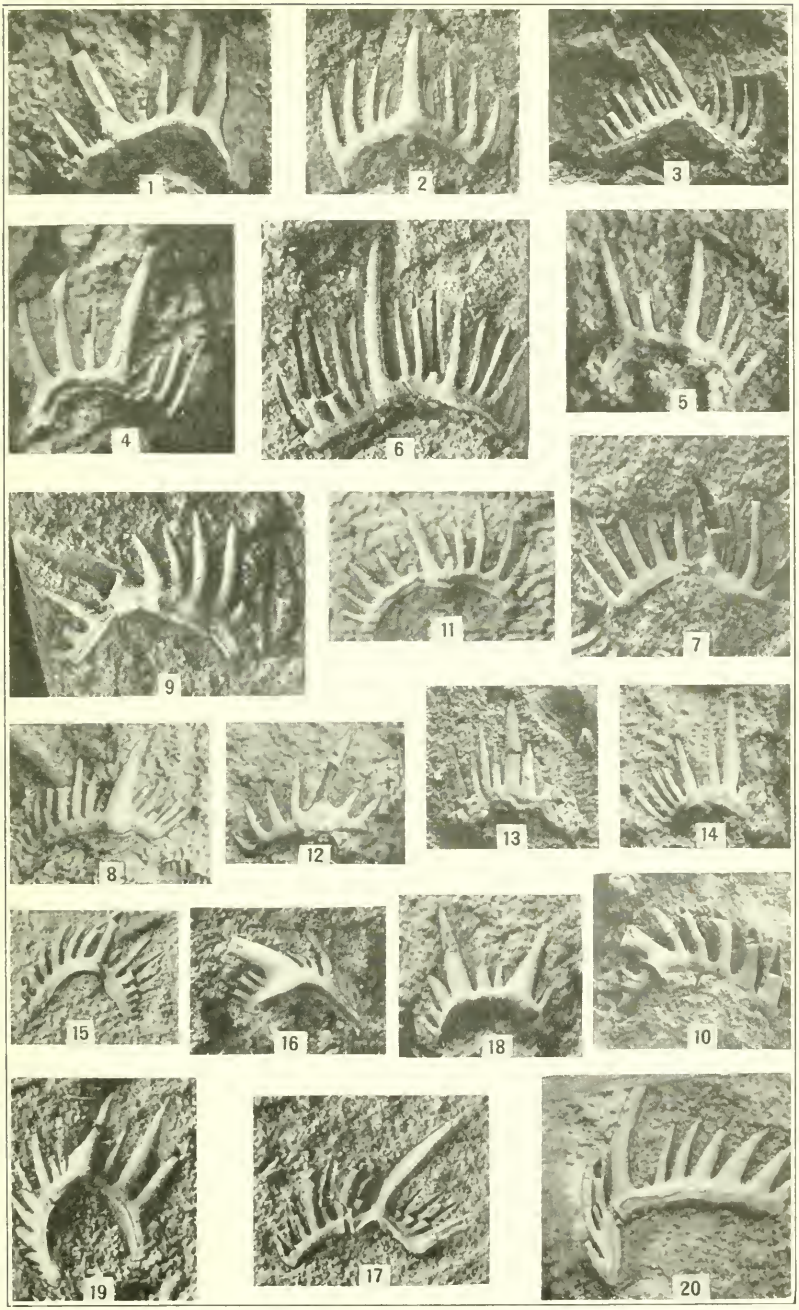


AMERICAN DEVONIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGES 56 AND 57

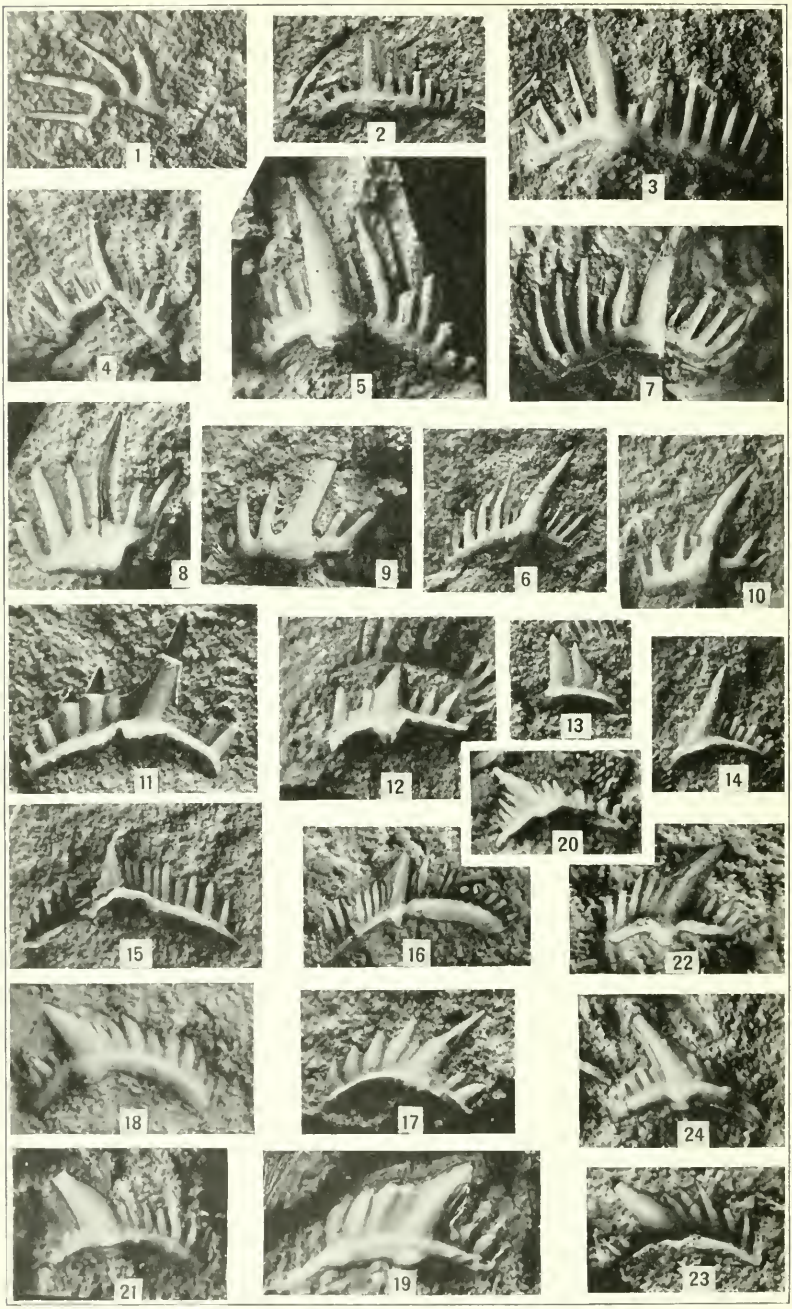
AMERICAN DEVONIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGES 57 AND 58



AMERICAN DEVONIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGE 58



AMERICAN DEVONIAN CONODONTS

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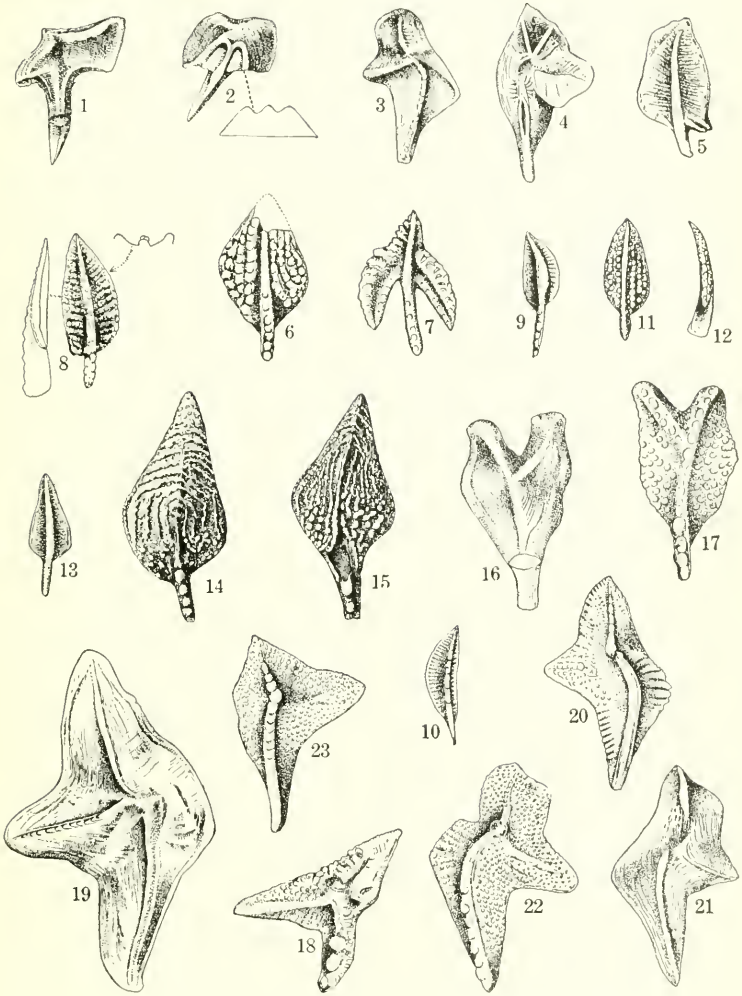
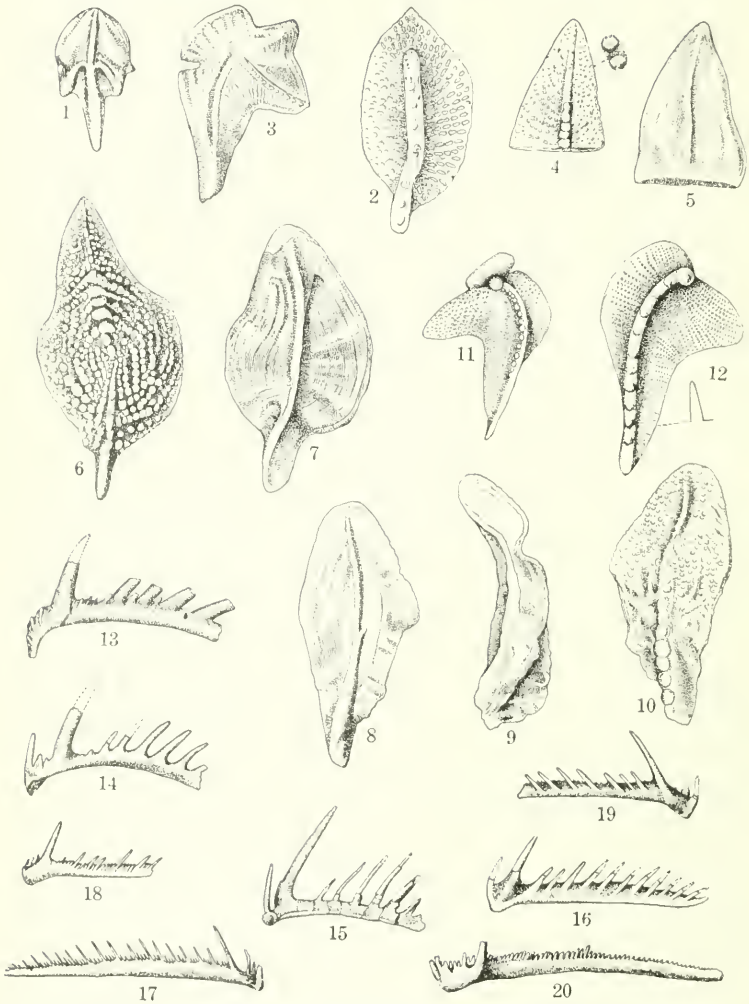


AMERICAN MISSISSIPPIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGES 59 AND 60



AMERICAN MISSISSIPPIAN CONODONTS

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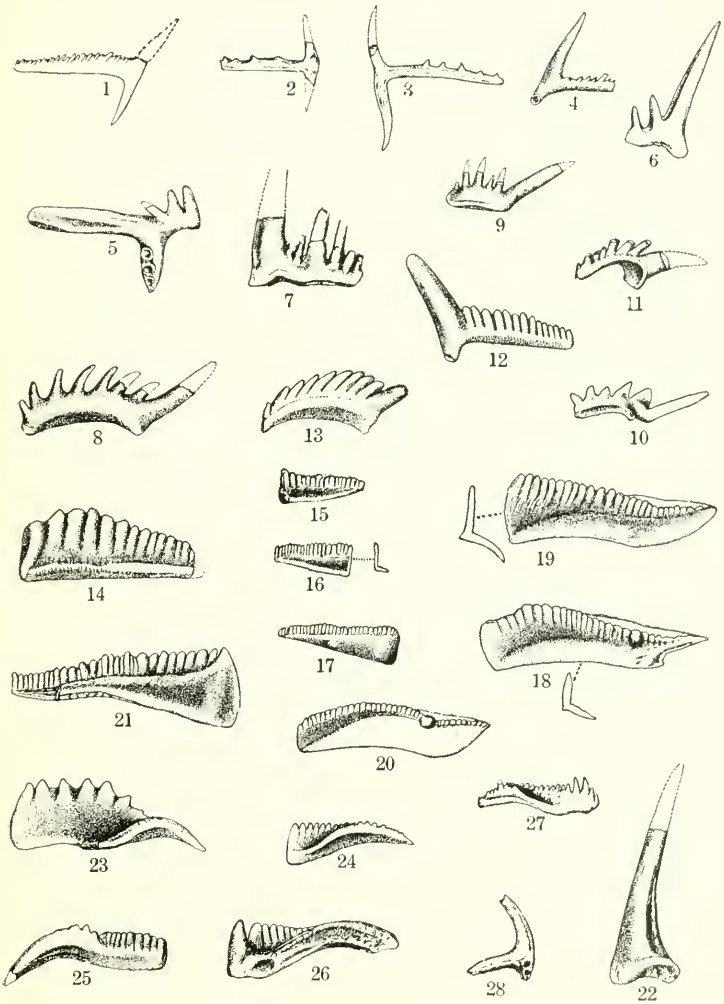

AMERICAN MISSISSIPPIAN CONODONTS

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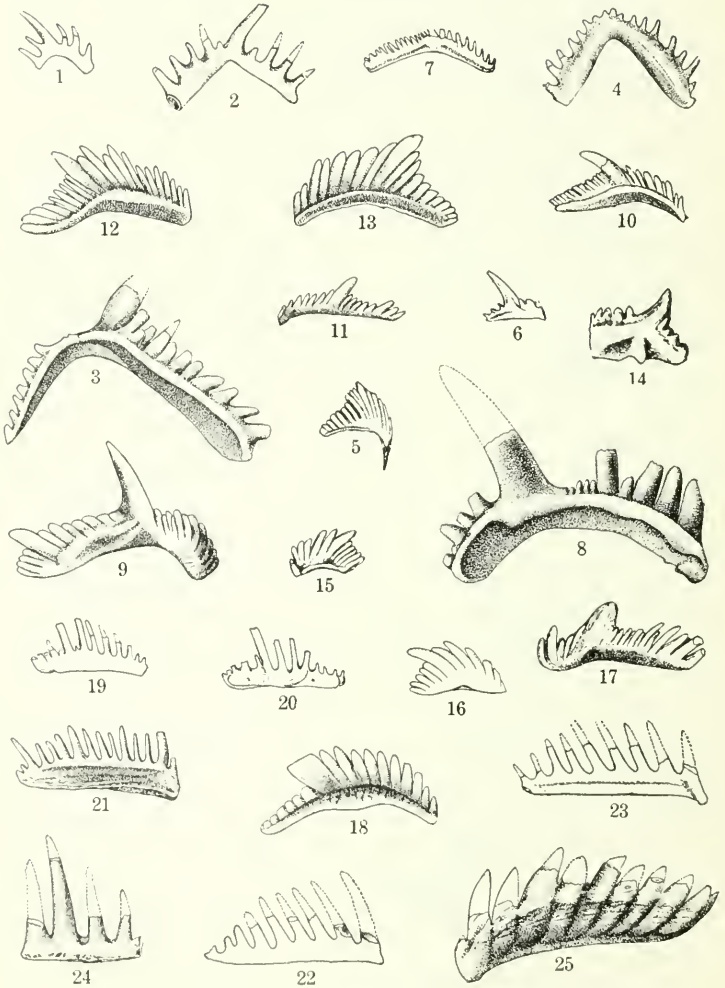
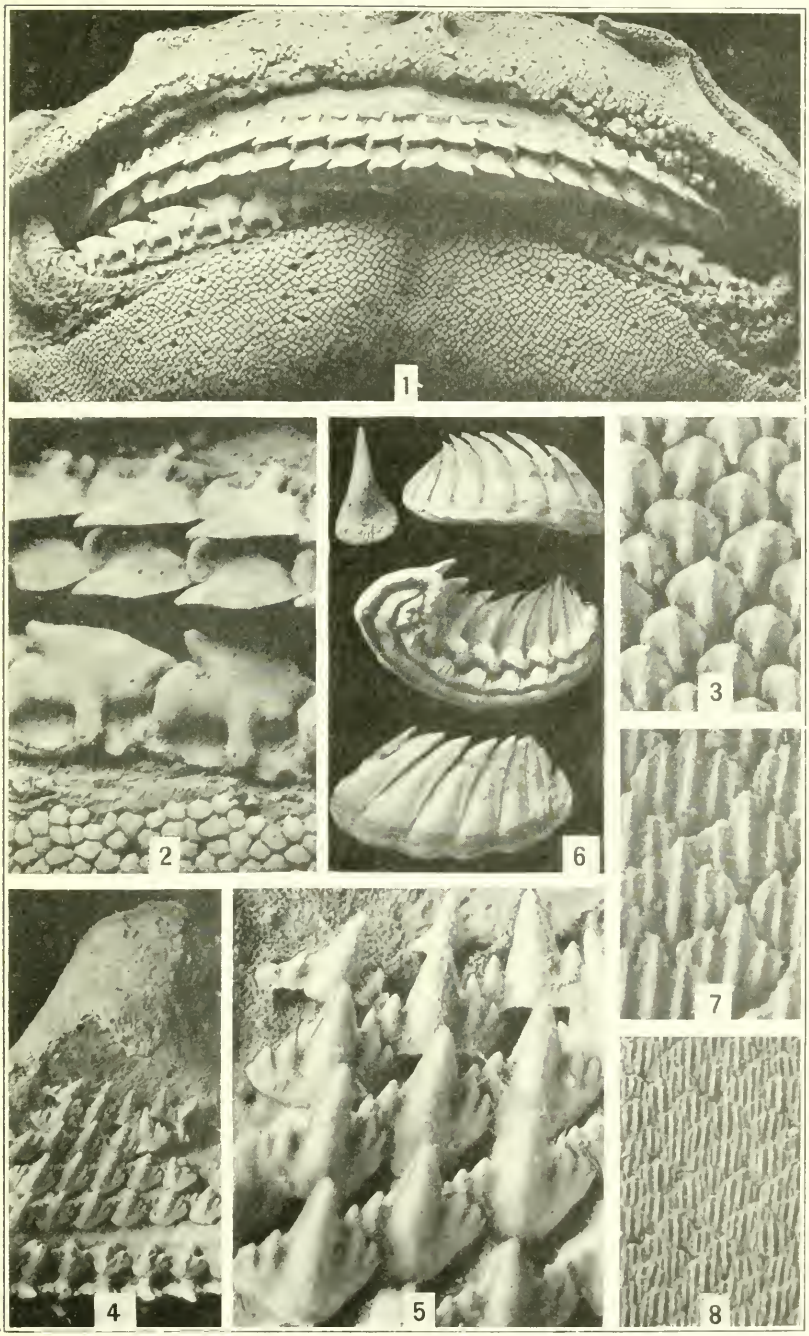


AMERICAN MISSISSIPPIAN CONODONTS

FOR EXPLANATION OF PLATE SEE PAGES 62 AND 63



TEETH AND DERMAL PLATES OF RECENT FISHES

FOR EXPLANATION OF PLATE SEE PAGE 63

PARASITIC NEMATODES FROM CHINA

By Benjamin Schwartz

Of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture

The following report is based largely on a collection of parasitic nematodes submitted for identification to the Zoological Division of the Bureau of Animal Industry by Dr. E. C. Faust of the Peking Union Medical College, Peking, China. In addition to the records based on the specimens submitted by Doctor Faust, many of which are new to China, two records based on China material in the Helminthological Collections of the U. S. National Museum as well as a number of records published by other investigators are included in this paper.

Heretofore our knowledge concerning parasitic nematodes from China has been largely limited to forms occurring in man, the parasitic nematode fauna of wild and domesticated animals having been practically unknown. The list of species given in the following pages contain not only many new records, but also represents an attempt to systematize our knowledge of these parasites from China.

Superfamily ASCAROIDEA Railliet and Henry, 1915

Family ASCARIDAE Cobbold, 1864

Genus ASCARIS Linnaeus, 1758

ASCARIS LUMBRICOIDES Linnaeus, 1758

Several immature specimens from the intestine of swine, collected in Peking in 1920 (No. 26403 U.S.N.M.). This species has been reported from man and from swine in various parts of China. Maxwell (1921) lists *Ascaris suilla* (=*Ascaris lumbricoides*) from *Canis familiaris* in China, this being the second report of the occurrence of this species in dogs, the first report being that of Leiper (1913) and the most recent record that has come to light being that of Ando and Asai, published in 1924 and reviewed recently (1925) in the Japan Medical World. These writers say that three dogs out of one hundred that were examined showed human *Ascaris* eggs in the feces.

No. 2614.—Proceedings U. S. National Museum, Vol. 68, Art. 13
60729—26†——1

ASCARIS VITULORUM Goeze, 1782

Several immature specimens from the intestine of a cow (*Bos*, species) collected in Yang Chun in 1920 (No. 26461, U. S. N. M.). This species has heretofore been reported from several localities in Asia, from Europe and from Africa. It is also known from the United States and from Cuba.

ASCARIS EQUORUM Goeze, 1782

Several immature specimens from the small intestine of a mule (*Equus mulus*) collected in Peking, in 1920 (No. 26426, U.S.N.M.).

Genus TOXOCARA Stiles, 1905

Synonym.—*Belascaris* Leiper, 1907.

TOXOCARA CANIS (Werner, 1782)

Synonym.—*Belascaris marginata* (Rudolphi, 1802).

A large number of specimens of this species were collected from the small intestine of foxes (*Canis vulpes*) in Mongolia in 1921 (No. 26408, U.S.N.M.). Maxwell (1921) reports *Ascaris canis* (probably *Toxocara canis*) from dogs in south Fukien. Faust (1921) reports this parasite from dogs in north China.

Family HETERAKIDAE Railliet and Henry, 1914

Genus SUBULURA Molin, 1860

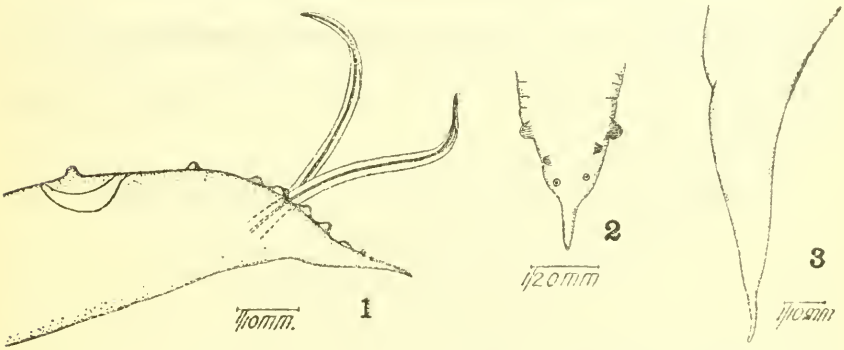
Railliet and Henry (1914) characterize this genus as follows:

Mouth, rarely with three lips, sometimes round, more often oval or hexagonal, the long axis being dorso-ventral. Buccal capsule with three teeth. Esophagus contains a distinct bulb. There are six cephalic papillae and often two lateral alae. Males may be provided with feebly developed caudal wings. Spicules equal; accessory piece present. Preanal sucker fusiform, without a chitinous ring. Vulva located in the region of the middle of the body. Eggs, subglobular, nearly always segmented when discharged.

SUBULURA CHINENSIS, new species

Cuticle transversely striated. Mouth apparently with three lips; buccal capsule about 63μ deep containing three small teeth at the base. The width of the anterior end of the buccal capsule is about 27μ and its maximum diameter is about 45μ. Lateral alae originate in the region of the lips and extend to a distance of from about 665 to 720μ from the cephalic extremity. The esophagus is from 1.3 to 1.4 mm. long and terminates in a slight prebulbous enlargement followed by a bulbous swelling about 225μ long by 180 to 225μ in diameter. The nerve ring is from 225 to 250μ, and the excretory pore about 430μ from the cephalic extremity.

Male.—The male is slightly over 10 mm long by about 360μ in maximum width. The spicules are filiform, equal, from 1.17 to 1.2 mm. long, and terminate in more or less sharp points (fig. 1). The gubernaculum is approximately 150μ long. There are 10 pairs of caudal papillae (fig. 1) of which five are pre and five post-anal. Of the former, the third is ventral in position, the remaining papillae having a lateral direction. The first and second papillae are isolated, the former being in the region of the sucker and the latter some distance from it. The three remaining preanal papillae are fairly close together. Of the postanal papillae, the last appears to have a ventral direction (fig. 2) whereas the first four are lateral. The first papilla in this group is very close to the anus. The longitudinal diameter of the sucker varies from 145 to 180μ. The tail ends in a slender tip.



FIGS. 1-3.—SUBULURA CHINENSIS. 1, POSTERIOR END OF MALE (LATERAL VIEW); 2, VENTRAL VIEW OF POSTERIOR END OF MALE; 3, POSTERIOR END OF FEMALE (LATERAL VIEW).

Female.—The females are from 12 to 14.7 mm. long by 450μ in maximum width. The vulva is located in the second third of the body dividing the latter into two parts whose proportions in two specimens are approximately as 7 is to 8, and as 10 is to 13, respectively. The vagina runs cephalad for a distance of 1.5 mm. and then turns dorsad where it joins the uterus. The tail is from 630 to 700μ long and tapers gradually (fig. 3). The eggs are from 72 to 81μ long by 45 to 51μ wide.

Host.—*Scops stictonotus.*

Location.—Intestine.

Locality.—Peking, China.

Type specimen.—U. S. National Museum Helminthological Collections, Cat. No. 26446.

Two species of *Subulura* heretofore described are known to occur in the genus *Scops*, one species (*Subulura acutissima* Molin) being from *Scops brasilianus* from Brazil, and the other species (*Subulura similis* Gendre) being from *Scops leucotis* from Africa. These two species are incompletely described, and so far as can be judged from

available figures they are different from the form described in this paper as shown by the position and arrangement of the papillae on the tail of male, although the number of papillae in these two species correspond to those in *S. chinensis*. The terminal portion of the male tail in *S. acutissima* is quite different from that of *S. chinensis* although the number of pre and postanal papillae are identical. While the terminal portion of the tail in *S. similis* resembles that of *S. chinensis* the arrangement and position of the papillae in the two species are different.

Family OXYURIDAE Cobbold, 1864

Genus ENTEROBIUS Leach in Baird, 1853

ENTEROBIUS VERMICULARIS (Linnaeus, 1758)

This parasite has been reported from man by various workers in China.

According to Faust (1922) oxyurids occur in practically all groups of vertebrates in China.

Superfamily FILARIOIDEA Weinland, 1858

Family FILARIIDAE Claus, 1885

Genus THELAZIA Bosc, 1819

THELAZIA CALLIPAEDA Railliet and Henry, 1910

Synonym.—Filaria circumocularis Ward, 1918.

According to Faust (1921) this worm has been reported from the eye of man and the dog from Chihli, north China, and from Fukien. Faust adds a third record from the dog in Anking, Anhivei, the parasite having been removed from the conjunctival sac of a dog. Barlow (1921) reports that he collected a live female specimen of *Thelazia callipaeda* from the feces of a Chinaman after the administration of an anthelmintic.

FILARIA BANCROFTI Cobbold, 1877

This species has been reported from man in China by various workers.

Genus DIROFILARIA Railliet and Henry, 1911

DIROFILARIA IMMITIS (Leidy 1856)

A single female from the heart of a fox (*Canis vulpes*) collected in Peking in 1922 (Cat. No. 26425, U.S.N.M.). According to Faust (1921) this species is of common occurrence in dogs in north China, 50 per cent of the animals being infected. Faust (1921) also reports this parasite from dogs in central Yangtze Valley.

Genus SETARIA Viborg, 1795

SETARIA EQUINA (Abildgaard, 1789)

Specimens from the small intestine of a mule (*Equus mulus*) collected in Peking in 1922 (Cat. No. 26428, U.S.N.M.). This parsite normally occurs in the peritoneal cavity, but has also been reported from other parts of the body including the intestine. The occurrence of this parasite in the intestine should, however, be viewed with suspicion owing to the possibility of accidental transfer in the course of necropsy.

SETARIA LABIATO-PAPILLOSA (Alessandrini, 1838 or Perroncito, 1882)

A single female from the "honeycomb" (reticulum) of *Bos taurus*, collected in Peking in 1921 (Cat. No. 26414, U.S.N.M.). So far as the writer is aware this is the first record of the occurrence of this parasite in the digestive tract. In view of the possibility of accidental transfer at necropsy this unusual location of the parasite is open to suspicion.

Superfamily SPIRUROIDEA Railliet and Henry, 1915

Family PHYSALOPTERIDAE Leiper, 1908

Genus PHYSALOPTERA Rudolphi, 1819

PHYSALOPTERA, species (larvae)

In addition to two presumably undescribed species of Physaloptera which are being studied by Dr. A. E. Chapin of this bureau, several larval *Physaloptera* from the liver of a badger, *Meles leptorhynchus*, collected in Peking in 1921, were examined by the present writer (Cat. No. 26413, U.S.N.M.). These larvae are about 8 mm. long by 414μ wide. The esophagus is 2 mm. long by 162μ in maximum width. The distance from the anterior extremity to the cervical papillae is 540μ, the nerve ring being half way between these points. The excretory pore is posterior to the cervical papillae. The tail is 270μ long.

Family SPIRURIDAE Oerley, 1885

Genus SPIROCERCA Railliet and Henry, 1911

SPIROCERCA SANGUINOLENTA (Rudolphi, 1819)

Adults specimens of this species were collected in 1921 from a "boil of the stomach" of a fox (*Canis vulpes*) in Mongolia (Cat. No. 26409, U.S.N.M.). Larval forms of this species from the mesentery of *Erinaceus dealbatus* were collected in Peking in 1922 (Cat. Nos. 26437, 26438, and 26441, U.S.N.M.). These larvae agree in all respects with Seurat's description of the larvae of *S. sanguinolenta*.

Seurat (1916) reports encysted larvae of *Spirocerca sanguinolenta* from a large variety of hosts in Algeria including *Erinaceus algirus*.

Genus ARDUENNA Railliet and Henry, 1911

ARDUENNA STRONGYLINA (Rudolphi, 1819)

One male specimen of this species, collected from *Sus scrofa domestica* in Kalgan in 1922 (Cat. No. 26433, U.S.N.M.). Location given in the original bottle is mesentery. Normally this parasite occurs in the stomach of swine, and its occurrence in the mesentery is probably due to an accidental transfer during necropsy.

ARDUENNA DENTATA (Linstow 1904)

Specimens were collected from the intestine of swine in Kuling in 1921 (Cat. No. 26452, U.S.N.M.). This species was described by von Linstow (1904) as *Spiroptera dentata* from *Sus cristatus*. Railliet and Henry (1911) transferred it to the genus *Arduenna* referring to its specimens collected from domestic swine in Annam, Indo-China.

Genus GONGYLONEMA Molin, 1857

GONGYLONEMA SCUTATUM (Leuckart, 1873)

These specimens were collected from the esophagus of *Ovis aries* in Peking in 1921 (Cat. No. 26421, U.S.N.M.).

Family GNATHOSTOMIDAE R. Blanchard, 1895

Genus GNATHOSTOMA Owen, 1836

GNATHOSTOMA SPINIGERUM Owen, 1836

These specimens were collected from *Felis domestica* in Peking in 1922 (Cat. No. 26431, U.S.N.M.). The location of these specimens as given on the label is "kidney wall."

Faust (1921) reports 4 specimens of this species from a gastric tumor in a cat in Wuchang. Faust (1921) also states that a related species was taken from a dog in the same locality. Inasmuch as *Gnathostoma spinigerum* also occurs in dogs, it is probable that the form from the dog in Wuchang belongs to the same species. Recently Morishita and Faust (1925) report two cases of human gnathostomiasis from China, one case being associated with "creeping disease." The parasites in question are probably *G. spinigerum*. Morishita and Faust (1925) also refer to three cases of *Gnathostoma spinigerum* in cats and to one case in a dog from central and north China.

GNATHOSTOMA HISPIDUM Fedtschenko, 1872

Maxwell (1921) reports this species from the stomach of the pig in south Fukien.

Superfamily STRONGYLOIDEA Weinland, 1858

Family STRONGYLIDAE Baird, 1853

Genus MONODONTUS Molin, 1861

MONODONTUS TRIGONOCEPHALUS (Rudolphi, 1805)

Numerous specimens of this species (8 lots) from the intestine of *Ovis* aries, the material having been collected in Peking in 1920 and 1921, in Wuchang in 1924 (Cat. Nos. 26401, 25416, 25417, 26422, 26424, 26455, 26458, and 26460, U.S.N.M.).

Genus AGRIOSTOMUM Railliet, 1902

AGRIOSTOMUM VRYBURGI Railliet, 1902

Several specimens from the intestine of a cow were collected in Yang Chun in 1920 (Cat. No. 26450, U.S.N.M.). This species is only known to occur in the Orient.

Genus ANCYLOSTOMA (Dubini, 1843)

ANCYLOSTOMA DUODENALE (Dubini, 1843)

This species has been reported from man by various workers in China.

ANCYLOSTOMA CANINUM (Ercolani, 1859)

Numerous specimens from the small intestine of domestic cat (*Felis domestica*) collected in Peking in 1920 and in 1922 (Cat. Nos. 26406, 26407, 26427, 26429, U.S.N.M.) and in Yu Tao Ho in 1920, also several specimens from the intestine of a wild cat (*Felis*, species) collected in Peking in 1921 (Cat. No. 26423, U.S.N.M.). Specimens from a dog (*Canis familiaris*) from China are present in the helminthological collections of the United States National Museum (Cat. 18681), this material having been collected by Doctor Shields. Maxwell reports this species from dogs in south Fukien. Faust (1921) reports this species from dogs in China.

Genus NECATOR Stiles, 1903

NECATOR AMERICANUS (Stiles, 1902)

This species has been reported from man in various parts of China.

Genus STRONGYLUS Goeze, 1782

STRONGYLUS EDENTATUS (Looss, 1900)

Specimens of this species were collected from the intestine of a donkey (*Equus asinus*) in Peking in 1922 (Cat. No. 26434, U.S.N.M.).

STRONGYLUS VULGARIS (Looss, 1900)

A number of specimens from the intestine of a horse (*Equus caballus*) were collected in Peking in 1922 (Cat. No. 26432, U.S.N.M.).

Genus OESOPHAGOSTOMUM Molin, 1861

OESOPHAGOSTOMUM APIOSTOMUM (Willach, 1891)

Several specimens from the intestine of a monkey (*Macacus tcheliensis*) collected in Peking in 1922 (Cat. No. 26448, U.S.N.M.).

OESOPHAGOSTOMUM DENTATUM (Rudolphi, 1803)

Specimens of this species from the large intestine and rectum of swine were collected in Changsha in 1921 in Wuchang in 1921, and in Peking in 1920 (Cat. Nos. 26404, 26451, and 26454, U.S.N.M.). Maxwell (1921) reports this parasite from the duodenum of swine in south Fukien. Faust (1921) reports this parasite from pigs in north China.

OESOPHAGOSTOMUM LONGICAUDUM Goodey, 1925

This species was described by Goodey from domestic swine in New Guinea. It is present in the China specimens of *Oesophagostomum* from swine forwarded by Doctor Faust. *O. dentatum* and *O. longicaudum* are present in the same bottles and presumably the two species occur in the same host animal. Specimens of *Oesophagostomum longicaudum* were also found by the present writer in material collected in Tonkin, Indo-China, in the Philippine Islands, in the Fiji Islands, and in the United States. *O. longicaudum* is probably of world-wide distribution.

OESOPHAGOSTOMUM COLUMBIANUM Curtice, 1893

This species is reported from the ileum of the goat in south Fukien by Maxwell (1921).

OESOPHAGOSTOMUM VENULOSUM (Rudolphi, 1809)

This species is reported from the jejunum, ileum, and large intestine of the goat in south Fukien by Maxwell (1921).

Family TRICHOSTRONGYLIDAE Leiper, 1912

Genus TRICHOSTRONGYLUS Looss, 1905

TRICHOSTRONGYLUS PROBOLURUS (Railliet, 1896)

Numerous specimens were collected from the small intestine of sheep (*Ovis*, species) in Peking in 1920 (Cat. Nos. 26418, 26419, and 26420, U.S.N.M.).

Genus HAEMONCHUS Cobb, 1898

HAEMONCHUS CONTORTUS (Rudolphi, 1803)

Specimens of this species from sheep collected by Doctor Shields in China are in the helminthological collections of the United States National Museum (Cat. No. 18682). Maxwell (1921) reports this species from the intestine of goats and from the stomach of a calf (*Bos*, species) in south Fukien.

Genus NEMATODIRUS Ransom, 1907

NEMATODIRUS FILICOLLIS (Rudolphi, 1802)

Specimens of this species were collected from the small intestine of sheep (*Ovis*, species) in Wuchang in 1920 and in Peking in 1921 (Cat. No. 26459, U.S.N.M.).

Family METASTRONGYLIDAE Leiper, 1908

Genus METASTRONGYLUS Molin, 1861

METASTRONGYLUS ELONGATUS (Dujardin, 1845)

This species was collected from the lungs of swine in Peking in 1920 and in Wuchang in 1921 (Cat. Nos. 26405, 26453, U.S.N.M.).

Genus CRENOSOMA Molin, 1861

CRENOSOMA VULPIS (Dujardin, 1845)

Specimens were collected from the lungs of a fox (*Canis vulpes*) in Mongolia 1921 (Cat. No. 26410, U.S.N.M.).

Superfamily TRICHUROIDEA Railliet, 1916

Family TRICHINELLIDAE Stiles and Crane, 1910

Genus TRICHINELLA Railliet, 1895

TRICHINELLA SPIRALIS (Owen, 1835)

Faust (1921) reports *Trichinella spiralis* from man in Peking and states that this parasite has not been found in hogs in Korea.

Family TRICHURIDAE Railliet, 1916

Genus TRICHURIS Roederer, 1761

TRICHURIS TRICHIURA (Linnaeus, 1771)

This species has been reported from man by various workers in China.

TRICHURIS OVIS (Abildgaard, 1795)

This species is reported from the caecum and large intestine of the goat by Maxwell (1921).

According to Faust (1922) trichurids occur in dogs, monkeys, hogs and hares in north China. The occurrence of *Hepaticola hepatica* (Bancroft, 1893) in rats in north China may be inferred from Faust's statements that "the liver of rats is sometimes packed with sandy patches of sediment, which on examination are found to be immense quantities of whipworm eggs."

Family ANGIOSTOMIDAE Braun, 1895

Genus STRONGYLOIDES Grassi, 1879

STRONGYLOIDES STERCORALIS (Bavay, 1876

This species has been reported from man by various workers in China.

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[1] This paper was not consulted.

TERMITES COLLECTED ON THE MULFORD BIOLOGICAL EXPLORATION TO THE AMAZON BASIN, 1921–1922

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The members of the Mulford Biological Exploration of the Amazon Basin expedition sailed from New York June 1, 1921, for Arica, Chile; the return was by way of Manaos and Para, Brazil, to New York, April 13, 1922. Dr. W. M. Mann, of the Bureau of Entomology, United States Department of Agriculture, collected practically all of the termites taken by this expedition. The headquarters were at: Canamina and Espia, Bolivia—July 14 to August 20; Huachi, Rio Bopi, Bolivia—August 23 to September 25; Rurrenabaque, Bolivia—October 2 to October 24; Lake Rogagua, Bolivia—October 28 to November 9; Rurrenabaque, Bolivia—November 14 to December 20; and Riberalta, Bolivia—January 6 to February 20. Studies and collections were made in various localities along the La Paz, Meguilla, Bopi, Cochabamba, Beni, Negro, Ivon, Madidi and Madeira Rivers.

The appended map (fig. 1) shows the route of this expedition. Seventy-seven species of termites were collected, including 36 new species, representing 26 genera and one new subgenus (*Agnathotermes*), in the families Kalotermitidae, Rhinotermitidae and Termitidae. Of these 26 genera, however, 14 may be considered to be subgenera. The families are represented as follows:

	Species	New species
Family Kalotermitidae:		
Genus *Neotermes* Holmgren	2	2
Family Rhinotermitidae:		
Genus *Leucotermes* Silvestri	1	0
Coptotermes Wasmann	1	0
Rhinotermes Hagen	4	2
Family Termitidae:		
Genus *Syntermes* Holmgren	2	0
Cornitermes Wasmann (sensu latiori)	6	1
Subgenus *Cornitermes* Holmgren (sensu strictore)	5	1
Labiotermes Holmgren	1	0

	Species	New species
Genus *Armitermes* Wasmann (sensu latiori)	9	3
Subgenus *Armitermes* Holmgren (sensu strictore)	7	3
Curvitermes Holmgren	1	0
Rhynchotermes Holmgren	1	0
Genus *Nasutitermes* Banks (sensu latiori)	25	10
Subgenus *Nasutitermes* Holmgren (sensu strictore)	15	3
Subulitermes Holmgren	1	1
Convexitermes Holmgren	2	2
Diversitermes Holmgren	3	1
Velocitermes Holmgren	1	1
Agnathotermes Snyder	1	1
Tenuirostritermes Holmgren	1	1
Constrictotermes Holmgren	1	0
Genus *Anoplotermes* Fritz Müller (sensu latiori)	14	11
Subgenus *Anoplotermes* Holmgren (sensu strictore)	13	11
Speculitermes Wasmann	1	0
Genus *Cylindrotermes* Holmgren	1	1
Genus *Mirotermes* Silvestri (sensu latiori)	4	2
Subgenus *Mirotermes* Wasmann (sensu strictore)	1	1
Spinitermes Wasmann	3	1
Capritermes Wasmann (sensu latiori)	5	3
Subgenus *Capritermes* Holmgren (sensu strictore)	0	0
Neocapritermes Holmgren	5	3
Genus *Orthognathotermes* Holmgren	2	1
Genus *Microcerotermes* Silvestri	1	0
Total	77	36

The termites collected by Doctor Mann have been compared with descriptions of termites collected by Prof. Nils Holmgren (1906)[1] on the Nordenskiöldi Expedition to South America. Professor Holmgren spent two months in Mojos (Prov. de Caupolican, Bolivia), one month in San Fermin (Province de Caupolican, Bolivia) [most of the collection at San Fermin was lost], and two months in Llinquipata and Chaquimayo (Province de Carabaya, Peru). Among 39 species collected by Holmgren, 26 were new.

[1] 1906. Holmgren, Nils. Studien über südamerikanische Termiten, Zoolog. Jahrbuch. Systematik Geographie und Biologie, vol. 23, pt. 5, pp. 521–676, Jena.

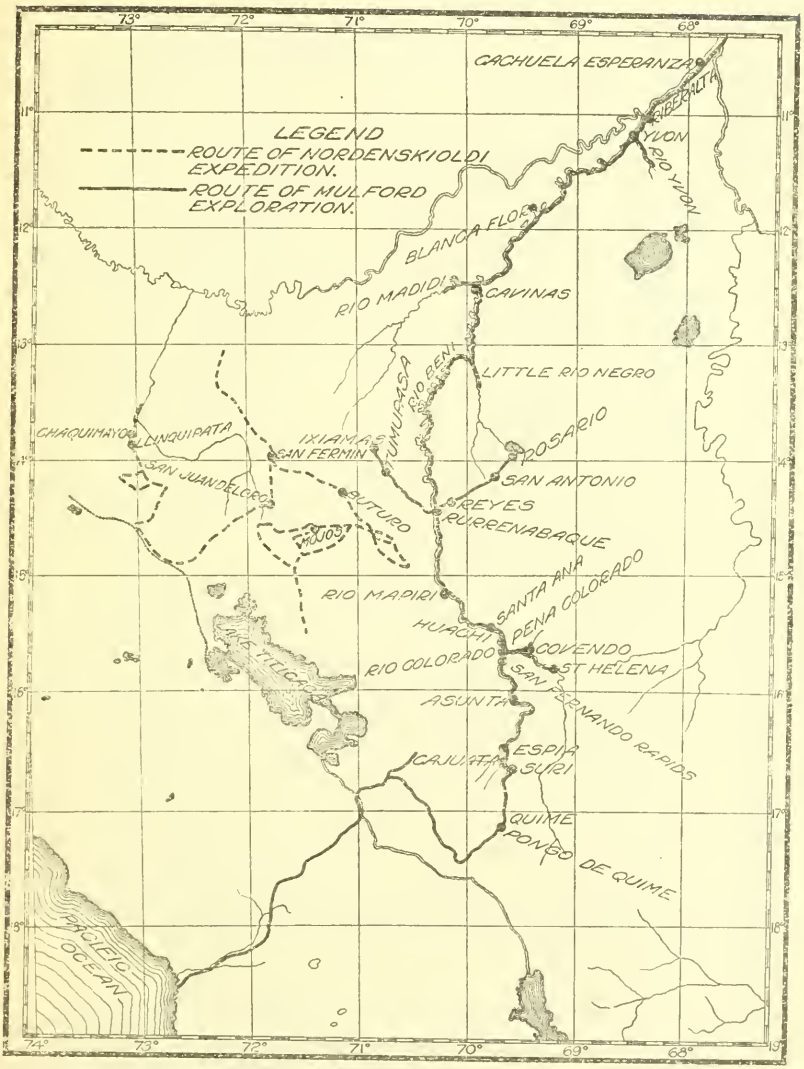

FIG. 1.—MAP SHOWING ROUTES OF THE SWEDISH (NORDENSKIÖLDI) EXPEDITION TO SOUTH AMERICA (BOLIVIA AND PERU), 1904–1905, AND THE MULFORD BIOLOGICAL EXPLORATION OF THE AMAZON BASIN (BRAZIL AND BOLIVIA), 1921–1922. ROUTES OF THESE TWO EXPEDITIONS TRANSFERRED TO MAP OF THE REPUBLIC OF BOLIVIA BY E. IDIAQUEZ (1901). (REPRINTED BY THE INTERNATIONAL BUREAU OF AMERICAN REPUBLICS.) ROUTE OF THE NORDENSKIÖLDI EXPEDITION TRANSFERRED FROM MAP (IN ZOOLOGISCHE JAHRBÜCHER, SYSTEMATIK, GEOGRAPHIE AND BIOLOGIE, VOL. 23, 1906) TO BASE MAP

Of these 39 species collected by Holmgren representing the families Rhinotermitidae and Termitidae, 21 genera are included; of these genera, 12 are considered as subgenera by Holmgren. The families are represented as follows:

	Species
Rhinotermitidae:	
Leucotermes Silvestri	1
Rhinotermes Froggatt	2
Termitidae:	
Syntermes Holmgren	2
Cornitermes (l. s.) Wasmann	3
Cornitermes (s. s.) Holmgren	2
Labiotermes Holmgren	1
Armitermes (l. s.) Wasmann	4
Armitermes (s. s.) Holmgren	2
Curvitermes Holmgren	1
Rhynchotermes Holmgren	1
Nasutitermes Banks (l. s.)	17
Nasutitermes Holmgren (s. s.)	9
Subulitermes Holmgren	2
Convexitermes Holmgren	2
Rotunditermes Holmgren	1

Termitidae—Continued.	Species
Nasutitermes—Continued.	
Diversitermes Holmgren	1
Velocitermes Holmgren	1
Constrictotermes Holmgren	1
Anoplotermes (l. s.) Fritz Müller	3
Anoplotermes (s. s.) Holmgren	2
Speculitermes Wasmann	1
Cylindrotermes Holmgren	1
Mirotermes (l. s.) Silvestri	3
Mirotermes (s. s.) Wasmann	1
Spinitermes Wasmann	2
Capritermes (l. s.) Wasmann	3
Neocapritermes (s. s.) Holmgren	3

The genus *Cylindrotermes* was described by Holmgren and one species only was found in Bolivia. Biological studies of the termites of Bolivia and Peru were also made.

The appended map (fig. 1) shows the route of the Nordenskiöldi Expedition, as well as that of the Mulford Exploration.

During 1919, 1920, and 1924 Dr. Alfred Emerson of the University of Pittsburgh made collections of termites at the Research Laboratory of the New York Zoological Society at Kartabo, Bartica District, British Guiana. Through the kindness of Doctor Emerson, I have been able to compare the termites collected by Doctor Mann in Brazil and Bolivia with a fine series of Emerson's manuscript paratypes (before publication). This comparison has enabled me to avoid duplication, has revealed that many species were identical and that the termite fauna of those portions of Bolivia traversed by the Mulford expedition is closely related to that of the vicinity of Kartabo, British Guiana.

The type species of termites from America in the Hagen collection located at the Museum of Comparative Zoology at Cambridge, Mass., were also carefully studied and doubtful species compared. Thanks are due to Dr. S. Henshaw and Mr. N. Banks for this privilege and their helpful courtesy

Detailed descriptions of the new species, redescriptions of some known species, and lists of the species, giving castes collected, locality and dates, follow herewith; these species are discussed in their taxonomic or systematic order.

Family KALOTERMITIDAE

KALOTERMES (NEOTERMES) MAGNOCULUS, new species

Winged, female adult.—Head light castaneous-brown, lighter at posterior margin, shining, longer than broad, slight depression and slope to front at epicranial suture, latter plainly outlined to ocelli as is median line, with scattered long hairs. Eyes blackish, very large, not round, close to lateral margin head, and separated from posterior margin by a distance about equal to their long diameter. Ocelli large, elongate, at angle to but close to eye.

Labrum light castaneous-brown, about three-quarters as long as broad, broadly rounded at apex, with long hairs.

Antenna pale yellow-brown, 17 segments, beadlike, pubescent; third segment short, subclavate, slightly longer than second or fourth; fourth, fifth, and sixth segments subequal, small and beadlike; segments become longer and wider toward apex.

Pronotum pale yellow-brown, probably slightly wider than head (corners turned down) not twice as wide as long, slightly emarginate anteriorly and posteriorly, sides rounded, with long hairs.

Legs pale yellow-brown, pubescent, claws *with no pulvillus.*

Wings white, punctate, costal veins yellow-brown, hairs on upper margins and on surface of lower margin, especially near scale; median vein runs close to subcosta, unbranched to apex (except for two indistinct, short, transverse branches to subcosta); subcostal vein with 7 (mostly long) branches to costa; cubitus in about the centre of the wing, slightly nearer to lower margin, with 11 branches to the lower margin. Wing scale 1.0 mm. in length.

Abdomen pale yellow-brown, with long and short hairs.

Measurements.—

Length of entire winged adult, 10.75 mm.
Length of entire deälated adult, 7.25 mm.
Length of head, 1.65 mm.
Length of pronotum (where longest, and not at median), 0.85 mm.
Length of hind tibia, 1.0 mm.
Length of anterior wing, 8.3 mm.
Diameter of eye (long diameter), 0.45 mm.
Width of head, 1.35 mm.
Width of pronotum, 1.35+ mm. (turned down).
Width of anterior wing, 2.45 mm.

This may be the winged caste of *N. manni* Snyder described from the soldier caste alone. Lighter colored and smaller than *N. fulvescens* Silvestri, with smaller eye.

Type locality.—Huachi, Bolivia.

Described from a single female winged adult collected at the type locality by W. M. Mann in September, 1921.

Type, winged adult, female.—Cat. No. 27644, U.S.N.M.

KALOTERMES (NEOTERMES) MANNI, new species

Soldier.—Head light castaneous-brown, not quite twice as long as broad, sides nearly parallel, slightly concave in middle, nearly flat, slight slope and depression at epicranial suture, which forms two lobes by a median division at its apex, with scattered long hairs. Eye spot very small, white, ocellus and trace of frontal gland also visible.

Mandibles dark castaneous-brown to black, fairly elongate and slender, with a high dorsal median ridge, giving a gouge-shaped mandible, incurved at tips; left mandible with two sharp, pointed marginal teeth at apical third, then a broad three-pointed molar (with the central tooth the most prominent) extending to base; right mandible with larger, sharp, pointed tooth at middle and a similar, lower adjoining tooth.

Gula narrow, width at middle one third as wide as at front.

Labrum yellow-brown, slightly broader than long, rounded at apex, with long hairs—two very long hairs at apex.

Antenna yellow-brown, 13–14 segments, pubescent; third segment sub-clavate, but not greatly modified or differing from the other segments, broader but not as long as (or slightly longer than) second segment; fourth segment bead-like, shorter than (or same size as) third segment; fifth segment slightly longer than fourth segment; from sixth segment on, segments become broader and much more elongate (or only slightly longer and more or less bead-like).

Pronotum yellow-brown, margins light castaneous, as wide as head; anterior margin shallowly, angularly concave; posterior margin nearly parallel to anterior margin; sides gradually and angularly slope to posterior, anterior corners higher, posterior margin slightly emarginate; pronotum with long but scattered hairs.

Legs white with tinge of yellow, tibiae and spines light castaneous, femora swollen.

Abdomen dirty grey, with tinge of yellow, with long hairs.

Measurements.—

Length of entire soldier, 9.00–10.50 mm.
Length of head with mandibles, 3.50–5.20 mm.
Length of head without mandibles (to anterior), 2.60–3.90 mm.
Length of left mandible, 1.15–1.45 mm.
Length of pronotum, 1.00–1.30 mm.
Length of hind tibia, 1.20–1.50 mm.
Width of head, 1.70–2.20 mm.
Width of pronotum, 1.70–2.20 mm.

Unlike in *K.* (*N.*) *castaneus* Burmeister, the hind femora are swollen. Without the winged adult there is difficulty in placing soldiers of certain species of *Kalotermes* in a subgenus.

Type locality.—Near mouth of Mapiri, Bolivia.

Described from a series of soldiers collected with nymphs at the type locality in September, 1921, by W. M. Mann; other specimens of soldiers from Huachi, August; Rio Colorado, September, 1921; Rosario, November, 1921; and Espia, Bolivia, Mann collector.

Type, soldier.—Cat. No. 27645, U.S.N.M.

Family RHINOTERMITIDAE

Genus RHINOTERMES Hagen

Only seven species of this genus have been previously described from America. The winged adult has the clypeus projected into a small noselike process or horn. There are two types of soldiers, the major strongly mandibulate and the minor with the elongate slender labrum forked at the apex, and fairly long, slender, pointed or vestigial mandibles.

In several new American species the major soldiers have the labrum remarkably elongate (pl. 1). The dimorphism of the soldier caste is very striking, there being marked structural differences between the major and minor soldiers.

RHINOTERMES LATILABRUM,[2] new species

Soldier, major (pl. 1, fig. 6).—Head straw-yellow, rim of antennal socket darker, labrum yellow-brown, lighter toward apex, base of mandibles yellow, but castaneous brown toward the apex and marginal teeth; head narrows anteriorly, rounded posteriorly, scattered long hairs on head. Labrum elongate as in minor soldier, broadest at base, with long hairs at apex. Mandibles elongate, slender, sharply pointed and incurved at the apex; prominent marginal teeth —as in figure; tips of two teeth broken on right mandible.

Antenna light yellow, 16 segments, with long hairs; third segment slender, subclavate, about same length as second but longer than fourth segment; segments beadlike, become longer and broader toward apex; last segment narrower and subelliptical.

Pronotum straw-yellow, margins darker, saddle-shaped, posterior margin markedly emarginate, anterior margin sharply raised up, rounded and narrowed; few scattered long hairs on posterior margin, few long hairs and more numerous short hairs on anterior margin.

Legs white, with tinge of yellow, fairly elongate, slender, pubescent (hairs long).

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[2] In a paper entitled "An Extraordinary New *Rhinotermes* from Panama," in Proc. Biol. Soc. of Washington, vol. 37, pp. 83–6, February 21, 1924, the writer referred to *R. latilabrum* Snyder as *R. intermedius* Snyder MS. Since it has been found that the name *intermedius* is preoccupied, this was later changed to *latilabrum*—emphasizing the relatively broad labrum of the major soldier caste.

Abdomen straw-yellow, with dense long hairs at base tergites, cerci prominent.

Measurements (*major soldier*).—

Length of entire soldier, 4.10 mm.
Length of head with mandibles, 1.75 mm.
Length of head without mandibles (to anterior), 1.05 mm.
Length of left mandible (base mandibles), 0.80 mm.
Length of labrum, 0.60 mm.
Length of pronotum, 0.35 mm.
Length of hind tibia, 0.85 mm.
Width of head (at widest point), 1.10 mm.
Width of labrum (at apex), 0.20 mm.
Width of labrum (at base), 0.22 mm.
Width (average) of labrum (at center), 0.20 mm.
Width of pronotum, 0.70 mm.

R. latilabrum Snyder has a broader head, and mandibles have longer, more robust and differently located teeth than in *longilabius* Emerson, as well as a broader labrum and longer and broader pronotum. The antennae have 16 segments whereas in *longidens* Snyder the antennae have only 15 segments, the labrum is broader at the apex than in *longidens*, and the posterior margin of the pronotum more emarginate.

Soldier, minor (pl. 1, fig. 9).—Head straw-yellow, margins and rim of antennal socket darker, labrum yellow-brown, broadest at posterior of antennal socket, sides slope gradually and roundedly to posterior margin, where rounded, conical at apex; head and labrum convex in profile; head with three rows of long hairs. Labrum elongate, slender, broadest at apex, with one long hair and dense short hairs on each fork at the apex. Mandibles yellow-brown, long, straight, slender, and sharp pointed (taper towards apex), nearly as long as one half the length of the labrum.

Antenna light yellow-brown, 14 segments, with long hairs; third segment subclavate, longer than second or fourth; fourth beadlike, shorter than second segment; segments become longer and broader toward apex; last segment conical.

Pronotum straw-yellow, darker on margins, saddle-shaped, anterior margin not sharply turned up, narrowed and rounded; pronotum raised up (convex in profile) at middle, sides roundedly slope to posterior margin which is slightly roundedly emarginate; a few long and short hairs on the margins.

Legs white with tinge of yellow, slender and with long hairs.

Abdomen light straw-yellow, with row of long hairs near base of each tergite, cerci prominent.

Measurements (*minor soldier*).—

Length of entire soldier, 2.90–3.15 mm.
Length of head with labrum, 1.25 mm.
Length of head without labrum (to anterior), 0.55 mm.
Length of labrum (to base of frontal gland), 0.63 mm.

Measurements (*minor soldier*)—Continued.

Length of left mandible, 0.35 mm.
Length of pronotum, 0.32 mm.
Length of hind tibia, 0.62 mm.
Width of head (at widest point), 0.60 mm.
Width of labrum (at base), 0.13 mm.
Width of labrum (at forks at apex), 0.13 mm.
Width of labrum (at center), 0.07 mm.
Width of pronotum, 0.47 mm.

R. latilabrum Snyder has a smaller head with fewer hairs and narrower labrum than *longilabius* Emerson (pl. 1, fig. 8); the anterior margin of the pronotum is raised up less sharply than in *longilabius;* the long pointed mandibles distinguish this species from *longidens* Snyder (pl. 1, figs. 1 and 10).

Type locality.—Rio Ivon, Bolivia.

Described from one major soldier and a series of minor soldiers, collected with workers at the type locality in February, 1922, by W. M. Mann. A deälated adult of *R. marginalis* Linnaeus was also collected with these specimens.

Type, major soldier.—Cat. No. 27646, U.S.N.M.; morphotype minor soldier.

RHINOTERMES MANNI, new species

Winged, male adult.—Head light yellow-brown (golden brown), clypeus somewhat darker, with scattered long hairs, a little longer than broad, sides roundedly slope to posterior margin, which is not transverse (as in *R. taurus* Desneux). Horn (clypeus) outlined by V-shaped grooves which originate at the fontanelle, elongate and broad with a median groove leading from the fontanelle, with a few long hairs anteriorly where rounded and curved down ventrally. Fontanelle hyaline, small round opening located well forward (on a transverse line with the anterior margin of the ocelli).

Eyes black, nearly round, projecting, close to lateral margin of head. Ocelli hyaline, suboval, slightly projecting, separated from eyes by a distance less than their diameter. Anterior to the ocelli are two large transversely placed quarter moon shaped hyaline spots.

Antenna pale yellow (third segment yellow-brown), 20 segments, with long hairs; third segment slender, elongate and markedly subclavate, longer than both the fourth and fifth segments together; from fourth segment on antennae bead-like, segments becoming longer toward apex; last segment slender and subelliptical.

Pronotum same color as head, not twice as broad as long, nearly rectangular, slightly saddle shaped, corners rounded and posterior margin slightly concave, with long hairs on margins.

Wing scale of forewing longer than pronotum, with long hairs, overlaps the base of the hind wing scale, which is shorter than the pronotum.

Wings gray-brown, costal veins golden-brown. In forewing median vein parallel and close to cubital vein, branches and reaches apex of wing in both wings, connected with subcosta by numerous slanting branches; subcosta with a few branches near apex in both wings; cubitus occupies most of the wing area, does not reach apex, with many branches to lower margin of wing. In hind wing median parallel and close to cubitus, branches and reaches apex of wing, more distant from subcosta than in forewing, cubitus does not reach apex of wing, with many branches to lower margin of wing.

Legs yellow, slender, elongate, with long hairs.

Abdomen yellow-brown (golden brown), paler ventrally, with dense long hairs; traces of styli present, cerci fairly elongate.

Measurements.—

Length of entire winged adult, 18.00 mm.
Length of entire deälated adult, 10.05 mm.
Length of head, 2.40 mm.
Length of horn, 0.70 mm.
Length of pronotum, 1.40 mm.
Length of hind tibiae, 3.00 mm.
Length of forewing, 13.05 mm.
Diameter of eye, 0.62 mm.
Width of head (at eyes), 2.35 mm.
Width of pronotum, 2.10 mm.
Width of forewing, 3.50 mm.

Described from a single male winged adult collected by W. M. Mann with major and minor soldiers at Cachuela Esperanza (Beni River), Bolivia, in March, 1922. The winged adult of *R. manni* Snyder is larger and lighter colored than *R. marginalis* Linnaeus and has a larger, differently shaped head and longer, broader horn than *R. taurus* Desneux, but is otherwise very close to *taurus; nasutus* Perty should replace *taurus*.

Soldier, major (pl. 1, fig. 5).—Head yellow-brown, flat, longer than broad, broadest posteriorly, with scattered long hairs. Fontanelle small with a groove leading from opening to labrum. Labrum yellow-brown, tongue-shaped, as broad as long, with a median groove, tip white, fleshy, broadly rounded, with short hairs. Mandibles black with castaneous-brown (reddish tinge) bases, bowed, with slender incurved tips; left mandible with two sharp marginal teeth near middle, first (upper) larger than second (lower); right mandible with upper tooth near middle, not prominent, parallel to rim, lower tooth prominent, sharp, near base.

Antenna yellow-brown, bead-like, 18 segments, pubescent; second segment short, cylindrical; third segment elongate, subclavate, as long as fourth and fifth segments together; fourth and fifth seg-

ments wedge-shaped; segments become beadlike towards apex; last segment elongate, semielliptical.

Pronotum light yellow-brown, margins darker, anterior margin raised, slightly emarginate, sides slope to anterior margin, which is concave, with long hairs.

Legs light yellow-brown, claws castaneous: slender, pubescent.

Abdomen light yellow-brown, with long, brown (reddish) hairs.

Measurements (*major soldier*).—

Length of entire soldier, 7.0–7.50 mm.
Length of head with mandibles, 4.0 mm.
Length of head without mandibles (to anterior), 2.50 mm.
Length of labrum, 0.70 mm.
Length of left mandible, 1.60 mm.
Length of pronotum, 0.80 mm.
Length of hind tibia, 2.10–2.15 mm.
Width of head, 2.35–2.45 mm.
Width of labrum, 0.70 mm.
Width of pronotum, 1.50 mm.

Soldier, minor (pl. 1, fig. 2).—Head light yellow-brown (lighter than in major soldier), lighter on sides and at posterior margin than on vertex, longer than broad, broadest anteriorly (at base of antennal socket where there is a tubercle), sides slope to posterior margin which is rounded, sides slightly concave, head with numerous long hairs. Post clypeus and labrum prolonged into a light castaneous-brown, chitinized rod, forked at the tip ("*gabel nasutus*"), this is narrow at the base and broadens to apex, with a median longitudinal groove, apex emarginate, forks fringed with dense short hairs and few long hairs. At base of this rod is the fontanelle produced into a short truncate tube directed towards the deep groove in the labrum.

Mandibles light castaneous-brown, slender, elongate.

Antenna yellow-brown, bead-like, 16 segments pubescent; third segment subclavate, twice as long as fourth; second longer than fourth; segments become longer and broader to apex.

Pronotum light yellow-brown, darker on margins; anterior margin elevated, sides slope to posterior margin, which is concave, with long hairs.

Legs light yellow, elongate, slender, pubescent.

Abdomen light yellow, with dense, long brown (reddish) hairs.

Measurements (*minor soldier*).—

Length of entire soldier, 5.5–5.55 mm.
Length of head with labrum, 2.20–2.35 mm.
Length of head without labrum (to anterior), 1.40–1.45 mm.
Length of labrum, 0.95 mm.
Length of left mandible, 0.375 mm.

Measurements (*minor soldier*)—Continued.

Length of pronotum, 0.60 mm.
Length of hind tibia, 1.50 mm.
Width of head (at widest portion), 1.05–1.1 mm.
Width of pronotum, 0.85 mm.

This species based on the soldiers has been named after Dr. W. M. Mann; the soldier is close to *R. hispidus* Emerson but is larger, the major soldier has a broader, more hairy head, and broader tooth to left mandible; the minor soldier also has a broader head.

Type locality.—Rurrenabaque, Bolivia.

Described from series of major and minor soldiers collected with workers at the type locality in October, 1921, by Dr. W. M. Mann.

Type soldier.—Major; morphotypes, male winged adult and minor soldier. Cat. No. 27647 U.S.N.M.

Other localities where this termite was collected are:

Rurrenabaque, Bolivia, October, 1921 (major soldier).

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (winged adult, major soldiers and workers).

A list of described species of the family *Rhinotermitidae*, with localities, dates, and castes, as well as localities other and additional to the type for the described species follows.

LEUCOTERMES TENUIS Hagen

Rosario, Bolivia, October and November, 1921 (winged, soldiers and workers) with *Anoplotermes pacificus* F. Müller (deälated and workers); Rurrenabaque, Bolivia, November, 1921 (soldiers); October (soldiers and workers); Ixiamas, Bolivia, December, 1921 (soldiers and workers); Tumupasa, Bolivia, December, 1921 (soldiers and workers); Cachuela Esperanza (Beni River) Bolivia, March, 1922 (soldiers and workers); Ivon, Bolivia, February–March, 1922 (soldiers and workers); Huachi, Bolivia, August–September, 1921 (soldiers and workers); Espia, Bolivia (soldiers and workers).

COPTOTERMES MARABITANUS Hagen

Rurrenabaque, Bolivia, November, 1921 (soldiers and workers); Rio Negro, Bolivia, January, 1922 (soldiers and workers); Rio Ivon, Bolivia, February, 1922 (soldiers and workers with *Armitermes holmgreni* Snyder, soldiers and workers, and *Nasutitermes ephratae* Holmgren (soldiers and workers).

RHINOTERMES MARGINALIS Linnaeus

Tumupasa, Bolivia, November, 1921. M. R. Lopez (deälated female adult); Rio Ivon, Bolivia, February, 1922 (deälated male adult) with *R. latilabrum* Snyder (major and minor soldier and workers); Ivon, Bolivia, February, 1922 (minor soldier and worker).

RHINOTERMES TAURUS Desneux [3]

Asunto, Bolivia, August, 1921 (major and minor soldiers and workers); Huachi, Bolivia, August–September, 1921 (major and minor soldiers and workers); Rurrenabaque, Bolivia, October, 1921 (also November, 1921, M. R. Lopez), (major and minor soldiers and workers); Cachuela Esperanza (Beni River), Bolivia, March, 1922 (major and minor soldiers and workers; Blanca Flor Beni, Bolivia, January, 1922 (major and minor soldiers and workers); Bon Hora, Rio Madeira, Brazil, March, 1922 (major and minor soldiers and workers).

Family TERMITIDAE

SYNTERMES BRAZILIENSIS Holmgren

Soldier (pl. 2, fig. 9).—Head yellow-brown (light castaneous), with reddish tinge anteriorly, shining, flatly arched, broadest near base, markedly narrowed toward front, with few scattered, light yellow, long hairs.

Fontanelle near front of head, opening projected into a very short tube (nearly flat, but little raised).

Antenna light castaneous brown, elongate, slender, 19–20 segments, with long pubescence, first segment elongate, cylindrical; second shorter and narrower, sub-clavate; third and fourth segments approximately the same size as second, or with third slightly longer than fourth but shorter than second, variable; fifth slightly longer than fourth; from sixth segment on segments become more elongate and slender; last segment elongate, slender, sub-elliptical.

Labrum light yellow brown, 3-lobed, central hyaline lobe white, fleshy, triangular, tip labrum with long hairs.

Post-clypeus light yellow-brown, not raised up.

Mandibles piceous, shining, elongate, slender, strongly incurved whereas in *S. molestus* Burmeister the mandibles are relatively weakly curved, tips pointed, base reddish-brown, broad, without hairs; left mandible with 2–3 small, somewhat blunt marginal teeth near base (see figure); right mandible with no marginal teeth.

Gula more than half the width of the front at the middle.

Pronotum light yellow-brown, saddle-shaped, without long spines (most unusual in species of *Syntermes*), instead of the spines the sides of the thoracic nota are produced to a blunt point (rudimentary or vestigial spine?) giving a three-cornered appearance, with long hairs.

Legs yellow-brown, elongate, slender, pubescent.

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[3] Major soldiers with larger heads but with narrower labrum than *R. marginalis* Linnaeus and less prominent marginal teeth. *R. nasutus* Perty replaces the species *taurus*.

Abdomen dirty-gray, with light-brown tinge, with long, dense hairs.

S. braziliensis is a larger species than *molestus* and differs in the relative curving of the mandibles.

The following measurements are based on a series of soldiers from Tumupasa, Bolivia, collected with workers by Dr. W. M. Mann, December, 1921, and on two soldiers collected on November 20, 1907, by D. Haseman, at Bomfin, Bahia, Brazil (Acc. No. 3441, Carnegie Museum, Pittsburgh, Pa.), the latter specimens being kindly loaned to me by Dr. A. Emerson.

Measurements.—

	Tumupasa, Bolivia	Bahia, Brazil
Total length of soldier	10–11 mm.	11.0 mm.
Length of head with mandibles	6.0 mm.	5.5–6.0 mm.
Length of head without mandibles	4.2–4.6 mm.	4.4–4.5 mm.
Length of pronotum	0.9–1.0 mm.	1.2 mm.
Length of left mandible	2.4 mm.	2.6 mm.
Length of hind tibia	3.35–3.5 mm.	3.6–3.7 mm.
Width of head (at broadest point)	3.34 mm.	3.55–3.6 mm.
Width of pronotum	1.75–1.85 mm.	2.0 mm.

S. braziliensis was described by N. Holmgren in 1911,[4] the description, however, is meager, consisting only of characters used in a key to the species of *Syntermes*. Only the soldier and worker castes are known.

SYNTERMES MOLESTUS Burmeister

Soldier (pl. 2, fig. 5).—Head light castaneous brown, slightly reddish anteriorly, shining, flatly arched, broadest near base, slightly narrowed anteriorly, with few scattered, light yellow, long hairs.

Fontanelle near front of head, opening (elliptical) projected into a very short tube, nearly flat (but little raised).

Antenna light yellow-brown, elongate, slender, with long hairs; third segment slightly longer than second, fourth equal to or slightly shorter than second.

Labrum light yellow-brown, 3-lobed, central hyaline lobe triangular, white, fleshy, tip of labrum with long hairs.

Post-clypeus light castaneous-brown, not raised up.

Mandibles piceous, shining, slender (more so than in *braziliensis* Holmgren), base reddish-brown, broad; mandibles relatively weakly curved, incurved at tips; left mandible with 2–3 small blunt marginal teeth near base (hidden by labrum); right mandible with no marginal teeth (pl. 2, fig. 5).

Gula more than half width of the front at the middle.

[4] 1911. Holmgren, N. 1. Bemerkungen über einige Termiten-Arten, Zoolog. Anzeiger, vol. 37, no. 26, pp. 547–8, 13 June.

Pronotum light yellow-brown, darker posteriorly than at front, saddle-shaped, without long spines at the sides; sides of thoracic nota produced into blunt points which are shorter than in *braziliensis*, with long hairs.

Legs yellow-brown, elongate, slender, pubescent.

Abdomen dirty-gray with tinge of yellow, with long dense hairs.

A smaller species than *braziliensis* Holmgren.

The following measurements compare specimens from Cuyabà and Independencia, Parhayba, Brazil.

Measurements.—

	S. molestus Burmeister, *Cuyabà*	*S. molestus* Burmeister, *Independencia*
Total length of soldier	8.90 mm.	9.50 mm.
Length of head with mandibles	4.70 mm.	5.10 mm.
Length of head without mandibles (to tip labrum)	3.30 mm.	3.70 mm.
Length of head without mandibles (to anterior)	2.90 mm.	3.30 mm.
Length of pronotum	0.90 mm.	0.90 mm.
Length of left mandible	1.70 mm.	1.80 mm.
Length of hind tibia	2.70 mm.	2.80 mm.
Length of labrum	0.60 mm.	0.50 mm.
Width of head (at broadest point)	2.50 mm.	2.80 mm.
Width of pronotum	1.40 mm.	1.50 mm.
Width of labrum	0.80 mm.	0.80 mm.

The soldier of *Syntermes molestus* is herewith described and figured for comparison with other species; the winged adult was described in Burmeister in 1839.[5] Silvestri in 1903 [6] described and figured the soldier.

Described from a single soldier from Cuyabà, Brazil, and determined by F. Silvestri as "*Termes molestus* Burm"; this specimen with workers was presented to the United States National Museum by Silvestri; this soldier (which was identified by Silvestri) has been compared with a soldier collected with workers by Mann at Independencia, Parahyba, Brazil; this specimen is also now in the collection of the United States National Museum. This soldier had a piece of dead leaf or grass in its mandibles.

SYNTERMES PERUANUS Holmgren

Soldier (pl. 2, fig. 8).—Head light castaneous brown, more reddish at front, shining, broad, broadest at base, strongly narrowed anteriorly, flatly arched, with but few scattered long hairs—fewer than in *S. dirus* (Klug) Burmeister, *snyderi* Emerson (pl. 2, fig. 7), or *chaquimayensis* Holmgren (pl. 2, fig. 4).

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[5] 1839. Burmeister, H. Handbuch der Entomologie, Neuroptera II, 2, pt. 1, p. 766. Berlin.

[6] 1903. Silvestri, F. Contribuzione alla conoscenzia dei termitidi e termitofili dell' America Meridionale Redia, vol. 1, pp. 51–2, pl. 2, figs. 86–8.

Fontanelle opening projected into a very short tube near front of head. Post-clypeus short, not raised. Labrum light castaneous brown, 3 lobed at apex, center lobe hyaline, with long hairs at apex.

Mandibles piceous, shining, elongate, slender, with stout reddish-brown base (few long hairs at the base), incurved and pointed at apex, marginal teeth as in figure. First marginal tooth on left mandible sharp pointed, near middle of mandible; mandibles longer and more slender than in *chaquimayensis;* marginal teeth nearer apex than in *snyderi;* marginal tooth on right mandible about same size as that on the left, just below it—slightly nearer the base.

Antenna reddish-brown, broken, 18+? segments, pubescent; third segment subclavate, longer than second or fourth; segments become more elongate and slender toward apex.

Pronotum yellow-brown with margins reddish, saddle-shaped; lateral spines are shorter than in *dirus*, *snyderi*, or *chaquimayensis;* also those on meso and meta-nota are shorter.

Legs yellow-brown, tibiae darker, elongate, with long hairs.

Abdomen light castaneous brown, densely covered with light yellow, long hairs.

Measurements.—

Total length of soldier, 15–17 mm.
Length of head with mandibles, 9.9–10.0 mm.
Length of head without mandibles (to tip labrum), 8.15–8.4 mm.
Length of head without mandibles (to anterior of head), 7.0–7.1 mm.
Length of labrum (to base central hyaline lobe), 1.1–1.2 mm.
Length of pronotum, 1.6 mm.
Length of hind tibia, 6.75 mm.
Length of left mandible, 3.5–3.8 mm.
Width of head (at broadest point), 6.9 mm.
Width of labrum, 1.5–1.6 mm.
Width of pronotum (to tip of spines), 4.45–4.5 mm.

The soldier of *S. peruanus* is close to *S. emersoni* Snyder but is slightly darker colored and the marginal teeth on the mandibles are longer in *peruanus* and are arranged differently and there are other differences in the size of the pronotum and the width of head. The lateral spines on the thorax are longer in *emersoni.*

Described from two soldiers kindly presented to the U. S. National Museum by Dr. A. Emerson from a series in the Carnegie Museum, Pittsburgh, Pa.—Acc. No. 4043 collected on October 9, 1909, at Villa Bella, Bolivia.

The species is known from both winged adults and soldiers and occurs in Peru and Bolivia.

Holmgren's description[7] is very meager, the characters merely being given in a key, hence the species is herewith described for comparison with other *Syntermes*.

Another known species of *Syntermes* collected by Doctor Mann is *Syntermes chaquimayensis* Holmgren, found at Huachi, Bolivia; soldiers and workers.

Genus CORNITERMES Wasmann

This genus is close to *Syntermes* Holmgren. In the soldier the frontal tube is better developed than in *Syntermes* but on the other hand the marginal teeth of the mandibles are not so well developed. In 1912, Holmgren divided the genus *Cornitermes* Wasmann into the subgenera *Cornitermes* (*sensu strictore*) Holmgren and *Labiotermes* Holmgren.

In *Cornitermes* (*sensu strictore*) the soldier has a long frontal tube and short, broad labrum, without a sharply defined hyaline apex; mandibles short and broad, left mandible with several fairly well-developed marginal teeth. In *Labiotermes* the soldier has the frontal tube relatively short, labrum long and with a sharply defined hyaline apex; left mandible with few, poorly developed marginal teeth.

The winged sexual adults are separated: *Labiotermes* large eyes and ocelli, latter close to eyes, antennae with 17 segments; *Cornitermes* (*sensu stricture*) medium large eyes and ocelli, latter more separated from eyes, antennae 15 segments. The sexual winged adults of *Cornitermes* show marked differences between the sexes.

CORNITERMES (CORNITERMES) BOLIVIANUS, new species

Winged, female adult.—Head dark castaneous brown, round fontanelle hyaline, sub-oval raised spot in a depression, larger than an ocellus, with few scattered long hairs. Post clypeus slightly lighter than head, projecting, bilobed. Eye black, large, projecting, not quite round, near lateral margin of head. Ocellus hyaline, sub-oval, upper rim projecting, separated from eye by a distance nearly equal to the long diameter of an ocellus.

Antenna yellow-brown, 15 segments, with long hairs; third segment sub-clavate, slightly longer than second or fourth segments; segments become longer and broader toward apex; last segment slender, sub-elliptical, pointed at apex.

Pronotum same color as head, anterior margin straight, posteriorly slightly emarginate (broadly and roundly), anterior corners high,

[7] 1911. Holmgren, N. 1. Bemerkungen über einige Termiten-Arten. Zool. Anzeiger, vol. 37, no. 26, 13 June, pp. 546–8.

sides roundly but gradually narrowed to posterior margin, markings on pronotum similar to those in *C.* (*C.*) *acignathus* Silvestri, with dense long hair.

Wings hyaline, costal area golden-yellow-brown, surface with numerous long hairs, margins ciliate. In forewing median nearer to cubitus than to sub-costa, branches down (5–7 sub-branches) before middle of wing, but forked to apex of wing, cubitus with 9–10 branches to lower margin of wing, only extends but a little beyond center of wing. In hind wing fewer sub-branches to median vein and cubitus extends further, has more branches and covers a wider area of the wing.

Legs yellow-brown, tibiae darker, elongate, slender, with long hairs.

Abdomen with tergites same color as head, two hyaline, slightly reni-form markings placed as in *acignathus*, but not as clear, with long hairs near base tergites, cerci not prominent.

Measurements.—

Length of entire winged adult, 17.50 mm.
Length of entire deälated adult, 8.00 mm.
Length of head (to tip of labrum), 1.90–2.00 mm.
Length of pronotum (to anterior corners), 1.05 mm.
Length of fore wing, 16.50 mm.
Length of hind tibia, 2.30 mm.
Diameter of eye (long diameter), 0.50 mm.
Width of head (at eyes), 1.90 mm.
Width of pronotum, 1.70 mm.
Width of fore wing, 4.30 mm.

The winged adult of *C.* (*C.*) *bolivianus* Snyder has a wider head and pronotum and the ocelli more distant from the eyes than in *C.* (*C.*) *striatus* Hagen; it has smaller eyes than *acignathus* Silvestri and narrower head and pronotum. There are marked differences in the sexual winged adults within the species in the genus *Cornitermes*.

Soldier.—Head yellow, darker anteriorly, broadest posteriorly, tapers (narrows) anteriorly, frontal tube slightly darker, elongate, slender and upturned (curved upward), with dense short hairs at apex, head convex in profile, with numerous long hairs. Labrum yellow, broadest in middle, triangularly rounded, apex hyaline, narrowed, with long hairs.

Mandibles blackish, fairly elongate and slender, sharp pointed apices incurved, marginal teeth on left mandible small (pl. 1, fig. 4), no marginal teeth on right mandible.

Antenna light yellow-brown, 15 segments, with long hairs; third segment sub-clavate, shorter than second or fourth segments; segments become longer and broader toward apex, last segment slender, elongate and sub-elliptical.

Pronotum whitish with tinge of yellow, saddle shaped, anterior margin emarginate, posteriorly broadly rounded, with scattered long hairs.

Legs white, tinged with yellow, elongate, slender, with long hairs.

Abdomen dirty gray-white, tinged with yellow, with dense long hairs; cerci prominent.

Measurements.—

Length of entire soldier, 5.80–6.30 mm.
Length of head with mandibles, 2.70–3.40 mm.
Length of head to anterior, 2.20 mm.
Length of frontal tube, 0.50 mm.
Length of left mandible, 1.25 mm.
Length of pronotum, 0.60 mm.
Length of hind tibia, 1.65 mm.
Width of head (posteriorly where widest), 1.95 mm.
Width of head (anteriorly), 1.40 mm.
Width of pronotum, 1.05 mm.

The soldier of *C.* (*C.*) *bolivianus* Snyder is distinctive due to the small size of the marginal teeth or denticles on the mandibles; the marginal teeth and the emargination or entirety of the anterior margin of the pronotum are excellent specific characters in the soldier caste of *Cornitermes*. *C. bolivianus* has the head tapering anteriorly, an upturned, slender frontal tube, head with dense long hairs, has 15 segments to the antenna, and has the anterior margin of the pronotum emarginate, hence differing from *C.* (*C.*) *lespesi* Fritz Müller.

Type locality.—Lago Rogagua, Bolivia.

Described from a series of winged adults and soldiers collected with workers at the type locality by M. R. Lopez in November, 1921. Soldiers and workers also collected at Cachuela Esperanza (Beni River) in March by Dr. W. M. Mann.

Type, winged female, adult.—Cat. No. 27648 U.S.N.M.; morphotype soldier.

Other described species of *Cornitermes* were collected, as follows:

CORNITERMES (CORNITERMES) CUMULANS Kollar

Reyes, Bolivia, October, 1921 (soldiers and workers); Ixiamas, Bolivia, December, 1921 (queen, soldiers and workers): Ixiamas, Bolivia, December, 1921 (queen, soldiers and workers, with soldiers and workers of *Leucotermes tenuis* Hagen); Ixiamas, Bolivia, December, 1921 (queen, soldiers and workers, with soldiers and workers of *Nasutitermes* (*N.*) *ephratae* Holmgren); Cavinas, Bolivia, February, 1922 (soldiers and workers); Rosario, Bolivia, No. 3, November, 1921 (queen, winged adults, soldiers and workers; Rosario, Bolivia, March, 1922 (soldiers and workers).

CORNITERMES (CORNITERMES) LESPESI Fritz Müller [8]

Cajuata, Bolivia (soldiers and workers); San Fanandr Rapids, Bolivia, August, 1921 (soldiers and workers); Rosario, Bolivia, November, 1921 (queen, soldiers, and workers); Rosario, Bolivia, November, 1921 (soldiers and workers with soldiers of *K.* (*Neotermes*) *manni* Snyder and soldier and workers of *Nasutitermes* (*N.*) *ephratae* Holmgren); Espia, Bolivia (soldiers and workers); Rurrenabaque, Bolivia, October, 1921 (soldiers and workers); Huachi, Bolivia, September, 1921 (soldiers and workers); St. Helena on Huichi, Bolivia, August, 1921 (soldiers and workers).

CORNITERMES (CORNITERMES) SIMILIS Hagen [9]

Rurrenabaque, Bolivia, November, 1921 (soldiers and workers); Ixiamas, Bolivia, December, 1921 (soldiers and workers, with soldiers and workers of *Nasutitermes* (*N.*) *ephratae* Holmgren); Blanca Flor, Beni, Bolivia, January, 1922 (soldiers and workers); Cavinas, Bolivia, January, February, 1922 (soldiers and workers); Ivon, Bolivia, February, March, 1922 (soldiers and workers); Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers and workers); St. Helena, Bolivia (soldiers and workers); Bon Hora, Rio Madeira, Brazil, March, 1922 (soldiers and workers).

CORNITERMES (CORNITERMES) STRIATUS Hagen

Asunto, Bolivia, August, 1921 (soldiers and workers); Tumupasa, Bolivia; December, 1921 (soldier and workers); Canamina, Bolivia, (soldiers and workers); Covendo, Bolivia, (soldiers and workers); Espia, Bolivia (soldiers and workers with *N.* (*Subulitermes*) *angusticeps* Snyder); Espia, Bolivia (soldiers and workers).

CORNITERMES (LABIOTERMES) LABRALIS Holmgren

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (queen, male, soldiers and workers; queen 24 mm. in length, 7.50 mm. in breadth; with *Nasutitermes* (*N.*) *ephratae* Holmgren, queen, soldiers and workers; *N.* (*Agnathotermes*) *glaber* Snyder, soldiers; *M.* (*Spinitermes*) *trispinosus* Hagen, soldiers and workers).

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (queen, soldiers and workers); Cachuela Esperanza, Beni River, Bolivia (soldiers and workers).

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[8] *C. lespesi* Fritz Müller has more marked small teeth or denticles beyond (toward the apex from) the pointed double marginal tooth on the left mandible than in *C. striatus* Hagen; this termite constructs large mound nests 1 meter in diameter.

[9] Anterior margin of pronotum as a rule more emarginate than in specimens of *C. similis* in the U. S. National Museum determined by F. Silvestri and presented to the Museum by Silvestri.

Genus ARMITERMES Wasmann

Holmgren in 1912 divided the genus *Armitermes* into three subgenera—*Armitermes* (sensu strictore) Holmgren, *Curvitermes* Holmgren and *Rhynchotermes* Holmgren; these subgenera are largely based on differences in the mandibles in the winged adult, soldier and worker castes. The subgenus *Armitermes* contains the greatest number of species—namely twelve, *Curvitermes* two, and *Rhynchotermes* three species. All of these species are confined to America. Dr. W. M. Mann collected species in all three subgenera in Bolivia.

The winged adult has the wings usually hyaline. The soldier caste has both mandibles and a nasus and forms a connecting link between the mandibulate and nasutiform types of soldiers.

There seem to be many closely related species or else there is great variation.

ARMITERMES (ARMITERMES) BENJAMINI, new species

Soldier.—Head light yellow-brown, nasus darker (light castaneous-brown), head broadest near base, only slightly narrowed towards anterior margin, not convex in profile, posterior margin of head rounded, head with few long hairs near anterior margin. Nasus does not extend to tips of mandibles, tapers to apex, where truncate and with short hairs, stouter than in *albidus* Hagen.

Gula elongate, relatively wide at middle.

Labrum yellow-brown, broadly rounded at apex, with long hairs.

Mandibles reddish-brown, yellow at base, elongate, slender but broader than in *albidus*, strongly bowed, but not as much so as in *albidus* Hagen, one short, sharp forward pointing tooth, broad at base, nearer to base than to apex.

Antenna yellow-brown, broken, second segment short, slightly longer than one-half of first segment.

Pronotum yellow, margins darker, saddle-shaped, with dense long hairs.

Legs white with tinge of yellow, pubescent.

Abdomen dirty gray white with yellow tinge, tergites with dense hairs, shorter than those on pronotum and relatively shorter than in *albidus*.

Measurements.—

Length of entire soldier, 5.60 mm.
Length of head with mandibles, 2.50 mm.
Length of head with nasus, 2.10 mm.
Length of head (to anterior), 1.50 mm.
Length of nasus, 0.70 mm.
Length of left mandible, 1.10 mm.
Length of pronotum, 0.35 mm.
Length of hind tibia, 1.20 mm.
Width of head (at widest point), 1.35 mm.
Width of pronotum, 0.70 mm.

Fewer hairs on head and with more taper toward anterior margin than in *percutiens* Emerson.

This termite is named in honor of the family of Edgar Laing Benjamin.

Type locality.—Cachuela Esperanza (Beni River), Bolivia.

Described from a single soldier collected at the type locality by Dr. W. M. Mann in March.

Type, soldier.—Cat. No. 27649, U.S.N.M.

ARMITERMES (ARMITERMES) HOLMGRENI, new species

Queen (first form).—Head dark castaneous-brown, longer than broad, round, tapers anteriorly, as *albidus*, four long hairs at each side of head behind eyes (*A. albidus* Hagen has a hairy head). Fontanelle distinct, linear, one line behind eyes. Eyes black, not quite round, large; ocelli elongate, set obliquely to eyes, from which they are separated by a distance equal to their small diameter. Labrum yellow-brown, tongue-shaped, broader than long, broadest at middle, apex white, with long hairs. Post-clypeus more than twice as broad as long.

Antenna yellow-brown, broken, pubescent; second segment longer than third or fourth; third subclavate, longer than fourth; segments become longer and broader toward apex.

Pronotum castaneous-brown, sides slope toward posterior margin, anterior corners high, emarginate posteriorly and slightly emarginate anteriorly, with long hairs.

Legs yellow-brown, elongate, slender, pubescent.

Abdomen with tergites yellow-brown, pubescent.

Measurements.—

Length of entire queen, 24.0 mm.
Length of head (to tip labrum), 1.40 mm.
Length of pronotum, 0.70 mm.
Length of hind tibia, 1.20 mm.
Diameter of eye (long diameter), 0.30 mm.
Width of head, 1.30 mm.
Width of pronotum, 1.00 mm.
Width of queen (abdomen), 7.70 mm.

Soldier.—Head yellow-brown, nasus light castaneous-brown, head broad, in profile not slightly concave (as in the case in *A.* (*A.*) *albidus* Hagen), head forms nearly a straight line with nasus, posterior of head somewhat oblique, head with few long hairs on posterior. Nasus stouter at base than in *albidus*.

Labrum yellow-brown, conical, with long hairs.

Mandibles reddish-brown, slender, strongly bowed, with sharp incurved points; marginal teeth as in *albidus*.

Antenna yellow-brown, with 14 segments, pubescent; third segment subclavate, longer than second or fourth; fourth shorter than second; segments become longer and broader towards apex; last segment slender and pointed at tip.

Pronotum yellow, darker on margins, saddle-shaped, emarginate anteriorly and posteriorly, with long hairs on margins.

Legs yellowish, elongate, pubescent.

Abdomen dirty gray with dense long pubescence.

Measurements.—

Length of entire soldier, 5.55–6.50 mm.
Length of head with nasus, 2.20–2.25 mm.
Length of head without nasus (to anterior), 1.30 mm.
Length of nasus, 0.90 mm.
Length of left mandible, 0.85 mm.
Length of pronotum, 0.45 mm.
Length of hind tibia, 1.40 mm.
Width of head, 1.35–1.40 mm.
Width of pronotum, 0.85 mm.

The queen of *holmgreni* Snyder has a lighter colored, broader, less hairy head than *albidus*.

In the abdomen of one soldier there was a white globular mass 0.50 mm. in diameter just behind the outside base of the metathoracic leg.

A larger soldier than *albidus* with a broader head and stouter nasus.

Type locality.—Ivon, Bolivia.

Described from an enlarged first form queen and a series of soldiers collected with workers at the type locality in February, 1922, by Dr. W. M. Mann.

Type, queen (first form).—Cat. No. 27650, U.S.N.M.; morphotype, soldier.

ARMITERMES (ARMITERMES) MANNI, new species

Soldier.—Head light yellow (straw color), nasus darker yellow-brown, somewhat retort-shaped in lateral view, broadest near base, weakly convex in profile, posterior margin of head somewhat oblique, head with few long hairs on dorsal surface near central and posterior portions. Nasus short, widens near middle then narrows, truncate at apex and with short hairs.

Labrum yellow-brown, with rounded off three-cornered apex, with long hairs.

Mandibles reddish-brown, slender, strongly bowed, with sharp incurved points and with one short, forward pointing tooth near the base.

Antenna yellow-brown, with 14 segments, pubescent; second segment longer than third; third slightly longer than fourth; segments become longer and broader toward apex; last segment elongate, sub-oval and pointed at apex.

Pronotum yellow, margins darker, saddle-shaped, with anterior margin strongly raised up, emarginate anteriorly and posteriorly, margins with dense long hairs.

Legs white with tinge of yellow, pubescent.

Abdomen dirty gray with tinge of yellow, tergites with dense hairs—shorter than those on pronotum.

Measurements.—

Length of entire soldier, 4.1–4.5 mm.
Length of head with nasus, 1.35 mm.
Length of head with mandibles, 1.40 mm.
Length of head without mandibles (to anterior), 0.90 mm.
Length of nasus (to anterior head), 0.45 mm.
Length of left mandible, 0.55 mm.
Length of pronotum, 0.30 mm.
Length hind tibia, 0.77 mm.
Width of head, 0.90 mm.
Width of pronotum, 0.50 mm.

Smaller than most species in the subgenus *Armitermes* (*sensu strictore*), near *neotenicus* Holmgren but smaller and with differences in the relative lengths of the second and third segments of the antennae.

Type locality.—Cachuela Esperanza (Beni River), Bolivia.

Described from a series of soldiers collected together with workers at the type locality in March, 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27651, U.S.N.M.

The following known species of *Armitermes* were also found:

ARMITERMES (ARMITERMES) ALBIDUS Hagen

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers, workers, and queen—11.3 mm. in length, 2.8 mm. in width, with elongate white egg—termitophile—placed longitudinally near middle of pronotum); (*Nasutitermes*, soldiers and workers, with above termites).

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers, workers, and queen—23 mm. in length, 5 mm. in width, with white eggs of termitophile on mesonotum and first 3 tergites).

ARMITERMES (ARMITERMES) EUAMIGNATHUS Silvestri

Ixiamas, Bolivia, December, 1921 (soldiers and workers, a few soldiers and workers of *Leucotermes tenuis* Hagen also present).

ARMITERMES (ARMITERMES) FESTIVELLUS Silvestri

Cavinas, Bolivia, February, 1922 (soldiers with *C.* (*Cornitermes*), species).

ARMITERMES (ARMITERMES) TEEVANI Emerson

Rio Madidi, Bolivia, February 1922 (soldiers and workers); Ixiamas, Bolivia, December, 1921 (soldiers and workers).

ARMITERMES (CURVITERMES) ODONTOGNATHUS Silvestri

Reyes, Bolivia, October, 1921 [soldier and workers with *N.* (*Velocitermes*) *uniformis* Snyder]; Ixiamas, Bolivia, December, 1921 (soldiers and workers with *M.* (*Spinitermes*) *robustus* Snyder, soldiers and workers).

ARMITERMES (RHYNCHOTERMES) NASUTISSIMUS Silvestri

Reyes, Bolivia, October, 1921 (soldier and workers).

Genus NASUTITERMES Banks

Species of *Nasutitermes* (*sensu strictore*) have the head of the winged adult more or less broadly oval to round; the post clypeus usually much shorter than half its breadth, usually light colored; segments of antennae usually not elongate; left mandible with first marginal tooth nearly as long as second.

The soldier is usually monomorphic, antennae usually not markedly elongate, 12–14 segments; nasus more or less conical, depression at base of nasus but slight; mandible with point.

The worker with post clypeus always much shorter than half its breadth.

Of all the genera of termites, *Nasutitermes* (*sensu strictore*) has the most species. Some species appear to be variable and to intergrade. N. Holmgren in 1909 established groups for the soldiers of certain similar American species; these groups and his key to American species are valuable aids to work in this genus.

The soldiers of *Nasutitermes* (*sensu strictore*) differ specifically in the length and breadth of the head; whether the profile of the head is straight, slightly convex or concave; size and shape of nasus; number of segments of antenna, relative size of third segment; position and number of bristles on head and presence or absence of pubescence; presence or absence of bristles and pubescence on tergites of abdomen; color; and size of worker.

In some species, the winged adult of *Nasutitermes* (*sensu strictore*) also shows variation. In *N. ephratae* Holmgren the size of the eye varies, sometimes being 0.50 mm. in diameter (long diameter) or smaller; the prominence of the ocelli also varies in some speci-

mens, in some, being much more projecting than in others. In *N. cornigera* Motschulsky the distance of the ocellus from the eye varies; indeed, I considered determining the specimens where the ocellus was closer to the eye than twice its diameter as *N. cayennæ* Holmgren, although the winged adult of this species is unknown; the soldiers of these two species appear to be the same. N. Banks, however, believes these two species may be the same, basing the decision on the soldier caste alone.

Of the 15 species collected by Dr. W. M. Mann, on the Mulford Expedition, only three are new.

NASUTITERMES (NASUTITERMES) ADUNCUS, new species

Soldier (pl. 2, figs. 1–2).—Head light castaneous-brown, smooth, shining, in profile nearly a straight line, slightly convex at base of nasus and depression on top of head, flat, dividing into two bulging cheeks or lobes at median line, sides of head slightly asymmetrical, two rows of long hairs, one on raised area at base of nasus, the other near posterior margin, head broadly pear-shaped. Mandibles with elongate sharp points.

Nasus dark castaneous-brown at apex, elongate, conical and robust, apex turned down, aquiline, with long hairs.

Antenna yellow-brown, with 13 segments, with long hairs; third segment elongate, clavate, longer than second or fourth segments; fourth longer than second segment; fifth longer and broader than fourth segment; sixth to ninth segments longer and broader, subequal; tenth to twelfth shorter and narrower, subequal; last segment slender, shorter and sub-elliptical.

Pronotum yellow, anteriorly yellow-brown, saddle-shaped, anterior margin emarginate, with long hairs.

Legs yellowish, tinged with brown, elongate, slender, with long hairs.

Abdomen with tergites yellow, tinged with brown, with a row of long hairs at base tergites and also dense long (but shorter) hairs on tergites; cerci prominent, elongate.

Measurements.—

Length of entire soldier, 4.40–4.65 mm.
Length of head with nasus, 2.10–2.15 mm.
Length of head without nasus (to anterior), 1.30 mm.
Length of nasus, 0.80 mm.
Length of pronotum, 0.30 mm.
Length of hind tibia, 1.70 mm.
Width of head, 1.30–1.45 mm.
Width of pronotum, 0.75 mm.

N. (*N.*) *aduncus* Snyder has a longer and broader head than *surinamensis* Holmgren, fewer hairs on the head and a more robust

nasus; *aduncus* differs from *maximus* Holmgren in its more robust, aquiline nasus, dense hairs on the tergites, but fewer hairs on the head.

Worker.—Head castaneous-brown, T-shaped, hyaline marking connecting median line and fontanelle. Antennae light yellow-brown, 14 segments.

Measurements.—

Length of entire worker, 5.50–6.00 mm.
Length of head, 2.25 mm.
Width of head, 1.80 mm.

N. (*N.*) *aduncus* is in the group with large workers (as *maximus* and *surinamensis*).

Type locality.—Rurrenabaque, Bolivia.

Described from a series of soldiers collected with workers at the type locality by Dr. W. M. Mann in October, 1921.

Type, soldier.—Cat. No. 27652, U.S.N.M.

NASUTITERMES (NASUTITERMES) AURANTIACUS Holmgren

Queen.—Head castaneous-brown, with reddish tinge, with dense long hairs. Fontanelle a raised subelliptical spot on vertex. Post clypeus slightly lighter colored than head, slightly over twice as broad as long, with long hairs. Eyes black, not round, projecting, not distant from lateral margin of head. Ocellus small, suboval, separated from eye by a distance equal to the long diameter of an ocellus.

Antenna yellow-brown, broken (10 segments), segments become longer and broader toward apex, with long hairs; third segment short and narrow, ring-like, shorter than second or fourth segments; fourth shorter than second segment.

Pronotum about same color as head, saddle-shaped, sides slope obliquely to posterior margin which is emarginate, with dense long hairs.

Legs yellow, with tinge of brown, with long hairs.

Abdomen with tergites castaneous brown, with grayish tinge, faint spiracular markings and dense long hairs; cerci not very prominent.

Measurements.—

Length of entire queen, 19.00 mm.
Length of head (to tip labrum), 1.25 mm.
Length of pronotum, 0.60 mm.
Length of hind tibia, 1.10 mm.
Diameter of eye (long diameter), 0.275 mm.
Width of abdomen of queens, 4.00 mm.
Width of head, 1.00 mm.
Width of pronotum, 0.85 mm.

N. (*N.*) *aurantiacus* Holmgren is more reddish colored than *N.* (*N.*) *minor* Holmgren, has a smaller head, and the smaller ocelli are more distant from the eye.

Described from a single first form queen collected at Rosario, Bolivia, in November, 1921, by W. M. Mann with soldiers and workers associated with *Microcerotermes arboreus* Emerson soldiers and workers in a tree nest; queen hitherto unknown. These specimens are deposited in the collection of the United States National Museum.

NASUTITERMES (NASUTITERMES) CRASSUS, new species

Soldier.—Head castaneous-brown (reddish tinge), smooth, shining, with two to three rows of bristles (on the base of the nasus, vertex, and posterior margin—last row sometimes not present), in profile nearly straight except for the elevation at the base of the nasus, head broadly rounded, flat on vertex. Nasus somewhat lighter colored, elongate, not very thick, turned down at apex. Mandibles with sharp points.

Antenna yellow-brown, with 13 segments, middle segments elongate, shorter toward apex, with long hairs; third segment elongate, subclavate, longer than second or fourth segments; fourth longer than second; fifth longer than fourth; last segment slender, shorter and subelliptical.

Pronotum yellow-brown, darker anteriorly, saddle-shaped, not emarginate anteriorly, with long hairs.

Legs light yellow-brown, elongate, slender, with long hairs.

Abdomen with tergites castaneous brown, with reddish tinge, with a row of long bristles at base of each tergite; cerci fairly long.

Measurements.—

Length of entire soldier, 4.00–4.20 mm.
Length of head with nasus, 1.80–1.90 mm.
Length of head without nasus (to anterior), 1.25 mm.
Length of nasus, 0.65 mm.
Length of pronotum, 0.30 mm.
Length of hind tibia, 1.45 mm.
Width of head, 1.30 mm.
Width of pronotum, 0.80 mm.

Worker.—Head castaneous-brown with gray tinge, hyaline markings, median longitudinal line connecting fontanelle with epicranial suture. Antenna 14 segments.

Measurements.—

Length of entire worker, 5.00–5.75 mm.
Length of head, 1.95–2.00 mm.
Width of head, 1.65–1.75 mm.

N. (*N.*) *crassus* Snyder comes in the group with large workers; it does not key down to any known species.

Type locality.—Rurrenabaque, Bolivia.

Described from a series of soldiers collected with workers at the type locality by W. M. Mann in October; other specimens collected at Huachi, Bolivia, in September.

Type, soldier.—Cat. No. 27653, U.S.N.M.

NASUTITERMES (NASUTITERMES) MINOR Holmgren

Winged adult.—Head castaneous brown, with dense long hairs. Fontanelle a slender hyaline slit forming with the epicranial suture a hyaline Y-shaped marking. Post clypeus yellow, slightly less than three times as broad as long, with dense long hairs.

Eye black, not round, projecting, close to lateral margin of head. Ocellus hyaline, large, suboval, projecting, at an oblique angle and close to eye.

Antenna yellow, 15 segments, segments become longer and broader toward apex, with long hairs; third segment subclavate, slightly shorter and narrower than second and fourth segments; fourth shorter than second; fifth shorter than fourth; last segment elongate, narrow and subelliptical.

Pronotum light yellow-brown, saddle-shaped, sides obliquely slope to posterior margin which is emarginate, with dense long hairs.

Meso- and meta-nota broadly emarginate, nearly straight, whereas in *N.* (*N.*) *aurantiacus* Holmgren the emargination is more distinct.

Wings dark, smoky dark grey, costal area yellowish, surface densely hairy, margin ciliate; in forewing median vein close to cubitus, entire to apex or unites with cubitus beyond middle of wing and branches (3) to apex; cubitus does or does not reach apex, in about middle of wing, with most branches heavy, apical branches lighter, 11–14 branches or sub-branches to lower margin of wing. Markings between subcosta and median veins.

Legs yellow, elongate, slender, with long hairs.

Abdomen castaneous-brown, with tinge of gray, with prominent spiracular markings and dense long hairs; cerci not prominent.

Measurements.—

Length of entire winged adults (males and females), 11.00–13.00 mm.
Length of entire deälated adults, 5.50–7.00 mm.
Length of head (to tip labrum), 1.50 mm.
Diameter of eye (long diameter), 0.375 mm.
Length of pronotum, 0.70 mm.
Length of anterior wing, 10.075 mm.
Length of hind tibia, 1.40 mm.
Width of head (at eyes), 1.30 mm.
Width of pronotum, 1.05–1.10 mm.
Width of anterior wing, 3.10 mm.

N. (*N.*) *minor* Holmgren has a very distinctive wing venation which however is variable.

Described from a series of winged adults collected with soldiers and workers at Rosario, Bolivia, in November by W. M. Mann, in wood of tree. The winged adult has been hitherto unknown. These specimens are deposited in the collection of the United States National Museum.

This species was also collected at the following localities: Espia, Bolivia (soldiers and workers); Rosario (Lake Rogogua), Bolivia, November, 1921 (soldiers and workers); Rosario, Bolivia, November, 1921 (soldiers and workers in wood of trees).

NASUTITERMES (NASUTITERMES) PILOSUS, new species

Soldier.—Head piceous, smooth, shining, nasus lighter (reddish-brown), pear-shaped, nearly straight in profile, elevated at base nasus and concave posterior to elevation; two rows of long hairs, one at base nasus, other on vertex of head. Nasus conical, not elongate or very thick. Mandibles with sharp points.

Antenna brown, 13–14 segments, segments become longer and broader toward apex, with long hairs; if 13 segments, third segment elongate, slender, subclavate, longer than second or fourth segments; fourth shorter than second; fifth longer than fourth or second; if 14 segments, third segment narrow, subclavate, shorter than second or fourth segments; fourth and second segments subequal; fifth slightly shorter or subequal, but sixth longer than fourth segment; last segment slender, short, and subelliptical.

Pronotum castaneous-brown, saddle-shaped; anterior margin darker, not emarginate, with long hairs.

Legs brown, slender, elongate, with long hairs.

Abdomen with tergites dark castaneous brown, with a row of long hairs at the base of each tergite and dense shorter hairs: cerci fairly elongate and prominent.

Measurements.—

Length of entire soldier, 3.80–4.00 mm.
Length of head with nasus, 1.55–1.65 mm.
Length of head without nasus (to anterior) 1.00–1.05 mm.
Length of nasus, 0.60 mm.
Length of pronotum, 0.20–0.25 mm.
Length of hind tibia, 1.35 mm.
Width of head, 0.95–1.05 mm.
Width of pronotum, 0.60 mm.

Worker.—Head dark colored, piceous, with a hyaline median longitudinal line connecting fontanelle and epicranial suture, with long and dense shorter hairs; antenna with 14–15 segments; tergites of abdomen with long and dense shorter hairs.

Measurements.—

Length of entire worker, 4.70–5.02 mm. (Average 4.70.)
Length of head, 1.40–1.65 mm.
Width of head, 1.25–1.35 mm.

N. (*N.*) *pilosus* Snyder is a dark colored species with tergites of abdomen hairy, and the worker is large and dark; *N.* (*N.*) *cayennae* Holmgren, var. *atriceps* Holmgren seems to be close but the description is very meagre.

Type locality.—Cachuela Esperanza (Beni River), Bolivia.

Described from a series of soldiers collected with workers at the type locality in March, 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27654, U.S.N.M.

Other known species of *Nasutitermes* which were collected are:

NASUTITERMES (NASUTITERMES) BRAZILIENSIS Holmgren

Ixiamas, Bolivia, December, 1921 (soldiers and workers).

NASUTITERMES (NASUTITERMES) CHAQUIMAYENSIS Holmgren

Tumupasa, Bolivia, December, 1921 (soldiers and workers).

NASUTITERMES (NASUTITERMES) CORNIGERA Motschulsky

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (Queen soldiers, and workers); Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers and workers); Huachi, Beni, Bolivia, September, 1921 (queen, soldiers, and workers); Huachi, Bolivia, Septembe, 1921 (winged adults, soldiers, and workers); Huachi, Bolivia, September, 1921 (soldiers and workers); Ivo, Bolivia (soldiers and workers, G. L. Harrington, Col. damaging book); Reyes, Bolivia, October, 1921 (soldiers and workers, M. R. Lopez); Reyes, Bolivia, November, 1921 (deälated male adult, M. R. Lopez); Rio Colorado, Rio Beni, Bolivia, September, 1921 (queen, soldiers, and workers); largest queen 26.50 mm. in length and 6.00 mm. in width); Rio Colorado, Rio Beni, Bolivia, September, 1921 (soldiers and workers); Rosario, Bolivia, November, 1921 (soldiers and workers); Rurrenabaque,[10] Beni, Bolivia, November, 1921 (winged, queen, soldiers, and workers); Rurrenabaque, Beni, Bolivia, October 1921 (winged, soldiers, and workers); Rurrenabaque, Beni, Bolivia, November, 1921 (queens, soldiers, and workers); Rurrenabaque, Beni, Bolivia, October, November, 1921 (queens, soldiers, and workers); Rurrenabaque, Beni, October, 1921 (soldiers and workers); San Bueno Ventura, Rio Beni, Bolivia, December, 1921 (soldiers and workers).

[10] *N.* (*N.*) *cornigera* Motschulsky, except the more common *N.* (*N.*) *ephratae* Holmgren, was the most common species collected by this expedition, and at Rurrenabaque, Bolivia, it appears to have been most numerous. This termite constructs carton "niggerhead" nests in trees, but also lives in logs, stumps, etc.

NASUTITERMES (NASUTITERMES) EPHRATAE Holmgren

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (queens, soldiers, and workers); Cachuela Esperanza, Beni, Bolivia, March, 1922 (soldiers and workers); Huachi, Beni, Bolivia, September, October, 1921 (queens, soldiers, and workers); Huachi, Bolivia (No. 11—five queens and three kings, soldiers and workers); Huachi, Beni, Bolivia, September, 1921 (soldiers and workers); Ixiamas, Bolivia, November, December, 1921 (queens, soldiers, workers); Ixiamas, Bolivia, December, 1921 (queen, soldiers, and workers with *Cornitermes* (*C.*) *similis* Hagen soldiers and workers); Ixiamas, Bolivia, December, 1921 (winged adults, soldiers, and workers); Ixiamas, Bolivia, December, 1921 (soldiers and workers); Peña Colorado, Upper Beni, Bolivia, September, 1921 (soldiers and workers—N. E. Pearson, Col.); Rio Ivon, Bolivia, February, 1922 (soldiers and workers); Rio Negro, Bolivia, January, 1922 (soldiers and workers); Rosario (Lake Rogagua), Bolivia, November (queen, soldiers, and workers); Rurrenabaque,[11] Beni, Bolivia, September, October, and November, 1921 (queen and king, soldiers and workers; the largest queen being 27.50 mm. in length and 6.50 mm. in width); Rurrenabaque, Beni, Bolivia, September, October, and November, 1921 (queen, soldiers, and workers); Rurrenabaque, Bolivia, September, October, and November, 1921 (soldiers and workers); Tumupasa, Bolivia, December, 1921 (queen, soldiers, and workers); Tumupasa, Bolivia (soldiers and workers).

NASUTITERMES (NASUTITERMES) MACROCEPHALUS Silvestri

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers and workers); Ivon, Bolivia, February, 1922 (soldiers and workers); Rio Mautania, Brazil, March, 1922 (queen, soldiers, and workers).

NASUTITERMES (NASUTITERMES) MAJOR Holmgren

Riberalla, Bolivia, January, 1922 (soldiers and workers).

NASUTITERMES (NASUTITERMES) MAXIMUS Holmgren

Cavinas, Bolivia, February, 1922 (soldiers and workers).

NASUTITERMES (NASUTITERMES) MINIMUS Holmgren

Ivon, Bolivia, February, 1922 (queen, soldiers, and workers).

NASUTITERMES (NASUTITERMES) ROTUNDATUS Holmgren

Rio Colorado, Bolivia, September, 1921 (soldiers and workers).

[11] *N.* (*N.*) *ephratae* Holmgren was the species most frequently collected by this expedition; it apparently was most common at Rurrenabaque; this species builds carton "niggerhead" tree nests, as well as living in logs and stumps.

NASUTITERMES (NASUTITERMES) SURINAMENSIS Holmgren

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (soldiers and workers); Ixiamas, Bolivia, December, 1921 (soldiers and workers); Reyes, Bolivia, October, 1921 (soldiers and workers).

NASUTITERMES (SUBULITERMES) ANGUSTICEPS, new species

Soldier.—Head yellow, lighter anteriorly, nasus castaneous, pear-shaped, with only two rows of bristles, one row near anterior, other near posterior of head, also with dense short hairs; nasus elongate, slender, slightly turned up at apex (dorsally). Points of mandibles absent.

Antenna white with tinge of yellow, 12 segments, pubescent. First segment elongate, cylindrical; second shorter; third subclavate, narrower and slightly shorter than second; fourth broader and longer than third; last segment elongate, sub-elliptical.

Pronotum white with tinge of yellow; yellow-brown at anterior margin, saddle-shaped, anterior margin with long hairs.

Legs white with tinge of yellow, elongate, slender, pubescent.

Abdomen dirty gray, with dense short hairs but with few long hairs on dorsum (one row at base each tergite), bristles longer at end of abdomen.

Measurements.—

Length of entire soldier, 2.7–3.4 mm. (average 3.2 mm.).
Length of head with nasus, 1.2–1.4 mm.
Length of head without nasus (to anterior), 0.675 mm.
Length of nasus, 0.50–0.52 mm.
Length of pronotum, 0.087–0.1 mm.
Length of hind tibia, 0.575–0.6 mm.
Width of head, 0.48–0.50 mm.
Width of pronotum, 0.32.

N. (*S.*) *angusticeps* is close to *N.* (*S.*) *microsoma* Silvestri but is smaller and has a narrower head.

Type locality.—Espia, Bolivia.

Described from a series of soldiers collected at the type locality by W. M. Mann.

Type soldier.—Cat. No. 27655, U.S.N.M.

Subgenus CONVEXITERMES Holmgren

This subgenus of the genus *Nasutitermes* Banks was established by Holmgren in 1912, and is confined to South America. Only five species are as yet known, namely, *convexifrons* Holmgren, *nigricornis* Holmgren, both of Peru, *kartaboensis*, *mazaruniensis*, and *manni* Emerson of British Guiana. The soldier caste is characterized by a short, thick, and conical nasus.

NASUTITERMES (CONVEXITERMES) PALLIDUS, new species

Soldier.—Head, light yellow, straw-colored, nasus reddish-brown, profile of head convex, broadest posteriorly, where margin is rounded, gradually narrowed anteriorly, nasus conical and robust, head with dense long hairs, nasus with dense short hairs. Mandibles with no sharp points.

Antenna light yellow, 11 segments, pubescent; third segment shorter than second or fourth segments; segments after the fourth become longer and broader.

Pronotum white with tinge of yellow, saddle-shaped, about one third as long as broad, with long hairs at margins.

Legs white, with tinge of yellow, not very long, pubescent.

Abdomen dirty gray, with tinge of yellow, with dense short hairs and longer hairs at base of tergites.

Measurements.—

Length of entire soldier, 2.45–2.75 mm.
Length of head with nasus, 1.00 mm.
Length of head without nasus (to anterior), 0.60 mm.
Length of nasus, 0.40 mm.
Length of pronotum, 0.10 mm.
Length of hind tibia, 0.47 mm.
Width of head, 0.60 mm.
Width of pronotum, 0.30 mm.

N. (*C.*) *pallidus* is smaller and has a narrower head than *nigricornis* Holmgren and *convexifrons* Holmgren, *convexifrons* has not the dense long bristles on the head; it is lighter colored and has a broader head than *kartaboensis* Emerson; *pallidus* is lighter colored and has a narrower head than *manni* Emerson, where there are no long dense bristles on the head; it is lighter colored and has a broader head than *mazaruniensis* Emerson and has a more robust nasus, the length of the head to the anterior in *mazaruniensis* is longer than in *pallidus*.

Type locality.—Ivon, Bolivia.

Described from a large series of soldiers and workers collected at the type locality in February, 1922, by W. M. Mann. Other specimens collected at Cachuela Esperanza (Beni River) in March.

Type, soldier.—Cat. No. 27656, U.S.N.M.

NASUTITERMES (CONVEXITERMES) PULLICEPS, new species

Soldier.—Head dark castaneous-brown, base of nasus darker (blackish-brown), apex lighter with reddish tinge, broadly oval, convex in profile, with few scattered long hairs and dense shorter hairs. Nasus fairly elongate, conical but not very thick even at base, with hairs at apex.

Antenna yellow to light yellowish-brown, 11–12 segments, segments become longer and broader toward apex, with long hairs; third segment (if 11 segments) elongate, clavate, longer than second or fourth; fourth shorter than second segment; if 12 segments, third short, ring-like, shorter than second but subequal with fourth segment.

Pronotum yellow-brown, saddle-shaped, anterior margin short, steep, not emarginate, with short hairs.

Legs yellowish, elongate, slender, with long hairs.

Abdomen with tergites light yellow-brown, with microscopic hairs and a row of long hair at the base of each tergite lacking in the middle of the abdomen; cerci fairly elongate.

Measurements.—

Length of entire soldier, 2.40–2.90 mm.
Length of head with nasus, 1.16–1.20 mm.
Length of head without nasus (to anterior), 0.75 mm.
Length of nasus, 0.40 mm.
Length of pronotum, 0.12 mm.
Length of hind tibia, 0.65 mm.
Width of head, 0.65 mm.
Width of pronotum, 0.30 mm.

N. (*C.*) *pulliceps* Snyder is a dark colored, small species, with nasus not robust.

Type locality.—Cachuela Esperanza (Beni River), Bolivia.

Described from a series of soldiers collected with workers at the type locality in March, 1922, by Dr. W. M. Mann; with this termite were soldiers and workers of *Armitermes* (*A.*) *albidus* Hagen.

Type, soldier.—Cat. No. 276657 U.S.N.M.

Subgenus DIVERSITERMES Holmgren

Silvestri's remarkable species *diversimiles* was placed in this subgenus of *Nasutitermes* Banks by Holmgren in 1912. Holmgren had found the intermediate soldier caste in Bolivia; the species has been previously known to have only two types of soldiers. The major soldier has an unmistakable large rounded head and the intermediate soldier has a head constricted in the middle, of somewhat of the shape of an hour glass, as in *Velocitermes* Holmgren (pl. 3, figs. 1–4).

This subgenus is confined to South America; two species have been described—*diversimiles* Silvestri and *castaniceps* Holmgren.

NASUTITERMES (DIVERSITERMES) MELANOCEPHALUS, new species

Queen (first form).—Head blackish, dark reddish-brown near base of antennae, with dense short hairs and quite a few long hairs, wider than in *N.* (*Diversitermes*) *diversimiles* Silvestri. Fonta-

nelle hyaline, triangular, broader than in (*Velocitermes*) *heteropterus* Silvestri, also the lines of bifurcation at anterior are shorter.

Antenna light castaneous-brown (12 (+ ?) segments, pubescent; third segment slightly darker colored, clavate, elongate as in (*Velocitermes*), as long as fourth and fifth segments together; fourth segment slightly longer than second.

Eyes blackish, fairly large and projecting. Ocelli hyaline, prominent, separated from compound eyes by a distance fully equal to their long diameter.

Labrum white with brownish tinge in center, tongue-shaped; darker colored than in *N.* (*V.*) *heteropterus.*

Post-clypeus light castaneous-brown, bilobed, projecting, three times as broad as long.

Pronotum darker castaneous-brown than post-clypeus, slightly raised anteriorly, also slightly emarginate anteriorly and posteriorly, sides slope sharply to posterior margin, which is fairly straight not rounded as in *N.* (*D.*) *diversimiles*, with long hairs; meso- and meta-nota lighter in color than pronotum, more elongate than in *diversimiles*, deeply, angularly emarginate posteriorly.

Legs yellow-brown; elongate, slender, pubescent; two elongate white eggs of a beetle (termitophile?) in ventral axis between tibia and femora of left prothoracic leg and one in joint on right fore leg.

Abdomen with tergites same color as meso- and meta-nota, with dense long hairs; sternites lighter colored, with golden-yellow tinge in center, with dense long hairs; abdomen with dense short hairs laterally.

Measurements.—

Length of queen, 16.0 mm.
Length of head (to tip labrum), 1.45 mm.
Length of pronotum, 0.80 mm.
Length of hind tibia, 2.15 mm.
Diameter of eye, 0.34 mm.
Width of head (at eye), 1.40 mm.
Width of pronotum, 1.30 mm.
Width of abdomen of queen, 3.8 mm.

N. (*D.*) *melanocephalus* is darker colored and has smaller eyes and shorter pronotum than *N.* (*Velocitermes*) *heteropterus.*

Soldier, major.—Head dark castaneous-brown to blackish, posterior and sides of posterior lobe of head lighter colored, as is base of antennae; tip of nasus light castaneous; head nasuate, semipear-shaped, not so constricted as *heteropterus*, unlike in *Diversitermes* where widest anteriorly, much wider posteriorly than anteriorly; only two rows of bristles on top of head at base of nasus and on apex of posterior lobe of head, three rows of bristles in *N.* (*V.*) *heteropterus* where there is an intermediate row (pl. 3, figs. 1–2).

Antenna castaneous-brown, elongate, 14 segments, slender pubescent; third segment clavate, nearly three times as long as second segment; fourth more than half as long as third; fifth subequal to fourth.

Pronotum lighter castaneous colored on margins than head, saddle-shaped, with long hairs.

Legs yellow-brown, elongate, slender.

Abdomen yellow-brown (lighter colored than in *N.* (*V.*) *heteropterus*), two rows of long hairs on tergites, dense long hairs at end of abdomen.

Measurements (*major soldier*).—

Length of entire soldier, 3.90–4.20 mm.
Length of head with nasus, 1.75–1.80 mm.
Length of head without nasus to anterior, 1.20–1.30 mm.
Length of nasus, 0.60–0.65 mm.
Length of pronotum, 0.20 mm.
Length of hind tibia, 1.50–1.55 mm.
Width of head, 0.95–1.07 mm.
Width of pronotum, 0.50 mm.

Head larger and darker colored than in *N.* (*V.*) *heteropterus*, with only 2 rows of bristles.

One soldier of this type ? is smaller and the head has a more elongate appearance; it is less wide at the base.

Measurements.—

Length of entire soldier, 3.85 mm.
Length of head with nasus, 1.60 mm.
Length of head without nasus to anterior, 1.20 mm.
Length of nasus, 0.50 mm.
Length of pronotum, 0.20 mm.
Length of hind tibia, 1.50 mm.
Width of head, 0.80 mm.
Width of pronotum, 0.47 mm.

Soldier, Intermediate.—Head of same color and with same bristles as major soldier, no wider posteriorly than anteriorly, constricted (pl. 3, figs. 3–4). Antenna 13–14 segments; third and fourth segments clavate, longer than second; second two-thirds as long as third; fourth not as long as third.

Measurements (*intermediate soldier*).—

Length of entire soldier, 3.8–4.1 mm.
Length of head with nasus, 1.45–1.55 mm.
Length of head without nasus to anterior, 1.10–1.20 mm.
Length of nasus, 0.45–0.55 mm.
Length of pronotum, 0.20 mm.
Length of hind tibia, 1.50–1.70 mm.
Width of head, 0.65–0.70 mm.
Width of pronotum, 0.50–0.55 mm.

This caste is apparently much more rare than the major and minor soldier castes.

Soldier, Minor (pl. 3, figs. 5–6).—Head of same color and with same bristles as major soldier, narrowed more gradually to nasus—more pear-shaped and more constricted. Antenna 14 segments; third and fourth segments longer than second, third twice as long, fourth shorter than third, fifth shorter than fourth.

Legs longer than in *N.* (*D.*) *diversimiles.*

Measurements (*minor soldier*).—

Length of entire soldier, 3.00–3.20 mm.
Length of head with nasus, 1.40–1.55 mm.
Length of head without nasus to anterior, 0.90 mm.
Length of nasus, 0.65–0.70 mm.
Length of hind tibia, 1.20–1.30 mm.
Length of pronotum, 0.15 mm.
Width of head, 0.60–0.70 mm.
Width of pronotum, 0.50 mm.

The minor soldier of *N.* (*Velocitermes*) *heteropterus* has 15 segments to the antenna and has a wider head; the bristles are differently placed in *N.* (*V.*) *velox* Holmgren.

There is some doubt in which subgenus *melanocephalus* should be placed, or whether a new subgenus should not be established. Although the soldiers have 14 segments to the antenna and are dark colored, *they are trimorphic and have relatively short legs*, while species of *Diversitermes* have only 13 segments to the antenna and are light colored; nevertheless this species has been included in *Diversitermes*, and not in *Velocitermes*, *where the soldiers are dimorphic and the legs are relatively long.* It apparently occupies an intermediate position between Holmgren's subgenera *Diversitermes* and *Velocitermes* and this and other data rather indicate that these subgenera are not valid. The post clypeus of the worker is nearly as long as half its breadth. Only two species of *Diversitermes* are known, both being from America; the soldiers have short legs, fairly long in the intermediate and minor types, the hind tibia are shorter than the entire head. The known species of *Velocitermes* have only 2 types of soldiers; only 3 species have been described as yet from America. In *Velocitermes* the third segment of the antenna of the winged adult is elongate and clavate, the soldiers have long legs, the hind tibiae being longer than the entire head.

Type locality.—Rosario, Bolivia.

Described from a series collected at the type locality by W. M. Mann in November, 1921; three soldier castes are morphotypes.

Type, first form queen.—Cat. No. 27658, U.S.N.M.; morphotypes, soldiers.

Other known *Diversitermes* found on this expedition are:

NASUTITERMES (DIVERSITERMES) CASTANICEPS Holmgren

Collected at Tumupasa, Bolivia, December, 1921, soldiers (major, intermediate, and minor), workers; soldiers (minor), workers.

NASUTITERMES (DIVERSITERMES) DIVERSIMILES Silvestri

Espia, Bolivia, soldiers (major, intermediate, and minor), workers; Rio Colorado, Rio Beni, September, 1921, soldiers (major and minor), workers; Rosario, Bolivia, soldiers (major, intermediate and minor), workers; Canamina, Bolivia, soldiers (intermediate and minor), workers; S. Helena (soldiers minor).

Subgenus VELOCITERMES Holmgren

This subgenus of *Nasutitermes* Banks was established by Holmgren in 1912; only four species have been described, all being from America, namely, *N.* (*V.*) *antillarum* Holmgren from San Domingo, *heteropterus* Silvestri from Paraguay and Brazil, *velox* Holmgren from Bolivia and Peru, and *beebei* Emerson from British Guiana. The soldiers are long-legged and rapid moving.

NASUTITERMES (VELOCITERMES) UNIFORMIS, new species

Winged adult.—Head blackish, shining, not much longer than broad, flattish but with slope anteriorly, rounded posteriorly, with dense long hairs. Fontanelle linear, constricted at the middle, two short lines at apex, following the epicranial suture. Eyes blackish, large, not round, close to lateral margin of head. Ocelli large, elongate, separated from eyes by a distance less than their short diameter.

Post-clypeus dark castaneous-(gray) brown, projecting, approximately one third as long as broad, with fairly long hairs.

Labrum yellow-brown, broader than long, broadly rounded at apex, with long hairs.

Antenna yellow-brown, 15 segments, pubescent; third segment subclavate, elongate, not quite twice as long as second segment; fourth segment slightly longer than second; fifth approximately equal to fourth; segments become longer toward apex; last segment slender, shorter and suboval.

Pronotum dark castaneous-brown, lighter colored than head, anterior margin nearly a straight line, slightly raised, corners high, sides rounded and gradually and roundedly slope to posterior margin, which is convex, with dense long hairs.

Meso-notum with posterior margin rounded but angularly and broadly (not deeply) emarginate; meta-notum with posterior margin less emarginate.

Wings markedly white, hyaline, even costal veins opaquely whitish, except near wing scale where there is a yellowish to yellowish-

brown tinge, margins ciliate, surface hairy. Median vein close to and parallel to cubitus, cubitus in about middle of wing area, with 12 branches to lower margin; wing scale hairy, 0.70 mm. in length.

Legs yellow-brown, pubescent.

Abdomen with tergites dark castaneous-brown, with dense short and long hairs; sternites lighter colored with central area yellow-brown.

Measurements.—

Length of entire winged adult, 13.5 mm.
Length of entire deälated adult, 7.5 mm.
Length of head (to tip labrum), 1.35 mm.
Length of pronotum, 0.80 mm.
Length of hind tibia, 1.85 mm.
Length of anterior wing, 11.5 mm.
Diameter of eye (long diameter), 0.35 mm.
Width of head (at eyes), 1.35 mm.
Width of pronotum, 1.20 mm.
Width of anterior wing, 2.80 mm.

Close to *heteropterus* Silvestri but darker colored and with broader head and larger eyes.

Major soldier (pl. 3, figs. 9–10).—Head dark castaneous-brown to black, head lighter colored at posterior margin, also at base of antenna, tip of nasus light castaneous; head semipear shaped, markedly constricted at anterior third, nasus forms rounded saddle with head, deeper than in *heteropterus* Silvestri, head broadest posteriorly, narrows anteriorly beyond constriction; three rows of long bristles on head. Nasus elongate, narrow. Mandibles prominent, elongate, narrow.

Antenna light castaneous-brown, 14 segments, pubescent; third segment elongate, slender, subclavate, over twice as long as second segment and longer than fourth segment; fourth segment subclavate, approximately of the same size as the fifth and sixth to ninth segments; tenth to fourteenth segments become gradually shorter; last segment slender and suboval.

Pronotum dark castaneous-brown, saddle-shaped, long bristles on anterior and posterior margins.

Legs yellow-brown, elongate, slender, pubescent, hind tibiae as long as head with nasus.

Abdomen with tergites light castaneous (gray) brown, row of long bristles at base of each tergite; sternites lighter colored with longer bristles, densest at end abdomen.

Major soldier darker than *N.* (*V.*) *heteropterus*, nasus at more of an angle to the head; different type of soldier than in *beebei* Emerson where the head is broadest anteriorly; type of soldier also different from that of *velox* Holmgren.

Measurements (*major soldier*).—

Length of entire soldier, 3.7–4.0 mm.
Length of head with nasus, 1.60–1.65 mm.
Length of head without nasus (to anterior), 1.00 mm.
Length of nasus, 0.65 mm.
Length of pronotum, 0.20 mm.
Length of hind tibia, 1.60–1.65 mm.
Width of head, 0.80–0.85 mm.
Width of pronotum, 0.50 mm.

This caste seems to be more common than the minor soldier.

Minor soldier (pl. 3, figs. 11–12).—Head dark castaneous-brown to blackish, narrowed more anteriorly than major soldier, same bristles; in general the same shape. Antenna 14 segments; third longer than second or fourth; from fifth to tenth, segments become elongate; from eleventh to fourteenth, shorter.

Measurements (*minor soldier*).—

Length of entire soldier, 3.35–3.6 mm.
Length of head with nasus, 1.45–1.50 mm.
Length of head without nasus (to anterior), 0.90 mm.
Length of nasus, 0.60 mm.
Length of pronotum, 0.15 mm.
Length of hind tibia, 1.45 mm.
Width of head, 0.70 mm.
Width of pronotum, 0.40 mm.

Minor soldier darker colored than *beebei* Emerson where there are only two rows of bristles on head and 13 segments to the antenna; in *antillarum* Holmgren there are also only 13 segments to the antenna.

The post clypeus of the worker is nearly as long as half its breadth.

Type locality.—Rosario, Bolivia.

Described from a single winged male adult and a series of dimorphic soldiers found together with workers in "termite hills" at the type locality, in November, 1921, by W. M. Mann. A series of winged adults together with dimorphic soldiers and with workers were also collected at Reyes, Bolivia, in October, 1921, by Mann. One soldier of *Armitermes* (*Curvitermes*) *odontognathus* Silvestoni was found with these specimens.

Type, winged male adult.—Cat. No. 27659, U.S.N.M., morphotypes soldiers.

Subgenus AGNATHOTERMES, new subgenus

Soldier.—Of only one type, contour of the head as in the subgenera *Tenuirostritermes* Holmgren or *Subulitermes* Holmgren, mandibles without points, nasus short and conical as in the subgenus *Convexitermes* Holmgren. Antenna with 11–12 segments. Light-colored species.

Worker.—Length of postclypeus nearly one-half its width, in species *aequalis.*

Genotype.—*Nasutitermes* (*Agnathotermes*) glaber Snyder from Cachuela Esperanza (Beni River), Bolivia.

In this subgenus also may be placed *N. (Obtusitermes) aequalis* Snyder from Camaguey, Cuba and "*Constrictotermes*" *pallidiceps* Banks from Haiti.

It is believed by the writer that the presence or absence of points on the mandibles is of relatively greater importance in systematic classification than the contour of the head or nasus, but a consideration of the latter as well necessitates a new subgenus for this species.

NASUTITERMES (AGNATHOTERMES) GLABER, new species

Soldier.—Head pale yellow, nasus red-brown, head pyriform, constricted back of base of antennae (at anterior quarter of head), broadest posteriorly, slightly convex but nearly straight in profile, with a slight depression at constriction, with scattered very short hairs and a few longer hairs anteriorly and posteriorly. Nasus short, conical, but not very thick, not turned up at tip, with short hairs and longer hairs at apex. Mandibular points absent.

Antenna pale yellow, 11 segments, pubescent; third segment longer than second or fourth; segments become longer and broader toward apex; last segment slender and subelliptical.

Pronotum with margins yellow, saddle-shaped, with short hairs.

Legs white, fairly elongate, slender, pubescent.

Abdomen dirty white, with short hairs on tergites, cerci fairly elongate.

Measurements.—

Length of entire soldier, 2.70 mm.
Length of head with nasus, 0.90 – 0.95 mm.
Length of head without nasus, 0.55 – 0.60 mm.
Length of nasus, 0.35 mm.
Length of pronotum, 0.10 mm.
Length of hind tibia, 0.57 mm.
Width of head, 0.50 mm.
Width of pronotum, 0.25 mm.

This species *glaber* was first referred to the subgenus *Obtusitermes* Snyder (which contains species with two types of soldiers); however, only one type of soldier, namely the major ? soldier, was found; *glaber* has characters intermediate between the subgenera *Convexitermes* Holmgren and *Subulitermes* Holmgren. The nasus is short and conical as in *Convexitermes* but the contour of the head is as in *Subulitermes.* No workers were collected with these soldiers and the species may be a *Tenuirostritermes* or in a new subgenus (*Agnathotermes*): the points of the mandibles are sometimes lacking in species

hitherto included in this subgenus (*Tenuirostritermes*) of Holmgren. The nasus is long and cylindrical in most species of *Subulitermes*, but this species may be in this subgenus.

Type locality.—Cachuela Esperanza (Beni River), Bolivia.

Described from 3 soldiers collected at the type locality with *Cornitermes* (*Labiotermes*) *labralis* Holmgren in March, 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27660, U.S.N.M.

NASUTITERMES (TENUIROSTRITERMES) LATICEPHALUS, new species

Soldier (pl. 3, figs. 7–8).—Head light yellow-brown (straw colored) with longitudinal striae (possibly muscles visible due to light color), broad but short—only slightly longer than broad; somewhat pear-shaped, narrowed and slightly constricted anteriorly, broadest at posterior margin which forms nearly a straight line (where slightly emarginate or divided into two lobes); two rows of bristles on dorsum of head, one row of 4 bristles anteriorly and the other row of 2 bristles posteriorly; head also with dense short hairs. Nasus light castaneous-brown, fairly short, slender, with short hairs. Mandibles prominent, short, sharp points.

Antenna yellow-brown, 13 segments, pubescent; third segment slender, clavate, longer than second or fourth; fourth shorter than second; fifth wider, nearly as long as third; segments become longer and wider toward apex.

Pronotum white, anterior margin yellow-brown, saddle-shaped; with short hairs.

Legs white with tinge of yellow, fairly elongate, pubescent.

Abdomen dirty gray, with tinge of yellow, a row of long bristles on each tergite, also short hairs, many long hairs at end abdomen.

Measurements.—

Length of entire soldier, 3.00–3.20 mm.
Length of head with nasus, 1.15–1.20 mm.
Length of head without nasus (to anterior), 0.80 mm.
Length of nasus, 0.40–0.45 mm.
Length of pronotum, 0.11 mm.
Length of hind tibia, 0.75–0.78 mm.
Width of head, 0.70–0.75 mm.
Width of pronotum, 0.35–0.36 mm.

This species is placed in the subgenus *Tenuirostritermes* due to the slight constriction of the head, the mandibles, legs, and the fact that in the worker the post-clypeus is twice as wide as long. The most striking characteristic of this species is its broad head, hence the specific name.

Type locality.—Covendo, Bolivia.

Described from a series of soldiers and workers collected by W. M. Mann at the type locality.

Type, soldier.—Cat. No. 27661 U.S.N.M.

Subgenus CONSTRICTOTERMES Holmgren

This subgenus of the genus *Nasutitermes* Banks was established in 1909 by Holmgren to include all species where the nasuti had constricted heads. In 1912, Holmgren restricted the subgenus to include only three American species with nasuti with markedly constricted heads—some of the most striking species of *Nasutitermes.*

The species found in Bolivia by Doctor Mann, namely, *N.* (*C.*) *cavifrons* Holmgren, was from a lobed nest on a tree; many other nests, apparently of this species, were nearby.

NASUTITERMES (CONSTRICTOTERMES) CAVIFRONS Holmgren

Ivon, Bolivia, February, 1922, queen, nasuti, workers.

NASUTITERMES (CONSTRICTOTERMES) CYPHERGASTER Silvestri

Soldier.—Head light castaneous-brown, dark brown to blackish posteriorly and at anterior of basal portion of posterior, wider, lobe of head at point of constriction; front of nasus also black; few long hairs on head.

Antenna light yellow, 14 segments, pubescent; third segment longer than second (but not twice as long); third and fourth segments about same length; fifth longer than third or fourth segments.

Pronotum light yellow, saddle-shaped.

Legs with tibiae yellow, elongate, slender, pubescent.

Abdomen gray-white with tinge of yellow, with long hairs on segments.

Measurements.—

Length of entire soldier, 4.80 mm.
Length of head with nasus, 1.85–1.90 mm.
Length of head without nasus (to anterior), 1.35 mm.
Length of nasus, 0.60 mm.
Length of antennae, 2.40 + mm.
Length of pronotum, 0.30 mm.
Length of hind tibia, 1.80–2.0 mm.
Width of head, 1.25 mm.
Width of pronotum, 0.64 mm.

The description is based on soldiers among Sörensen's material under the manuscript name "*reinhardii*" at the Museum of Comparative Zoology, Cambridge, Mass. By a comparison with Silvestri's description of *cyphergaster* (1903), I find that these species are identical. Hence, *Constrictotermes cyphergaster* Silvestri would replace *reinhardii* Sörensen, if the latter had been described. I

have examined Sörensen's paratypes (soldiers and workers) of "*reinhardii*" from Rio Grande, Brazil, in the Museum of Comparative Zoology, and redescribed the type for comparison with other species.

[*Eutermes*] *Microcerotermes strunckii* is the only valid species of the four species described as new by Sörensen in 1884.

Genus ANOPLOTERMES Fritz Müller

The winged adults of species of *Anoplotermes* have a very broad head usually densely hairy, with small projecting eyes. Fontanelle indistinct or large and prominent; see key. Ocelli fairly large, more or less distant from eyes. Postclypeus strongly arched, length usually less than half its width. Mandibles elongate, with a large apical tooth. Antennae always with 15 segments; third segment much shorter than the following (exception *A. silvestrii* Emerson).

Pronotum similar to that of species of *Nasutitermes*. Meso and metanota elongate, narrow, with posterior margin more or less deeply emarginate. Wings dark, hairy.

There are marked differences in the sexual, winged adults, between males and females.

In some species of the subgenus *Speculitermes* Wasmann the workers are darkly colored and the fontanelle is large, round, and prominent; the third segment of the antennae of the winged adult usually is large (approximately equal to the fourth)—not small as in *Anoplotermes* (*sensu strictore*). These species of *Speculitermes* live in earth nests in the crotches of trees near the ground, whereas some Central American species of *Anoplotermes* usually do not construct earth nests or mounds.

KEY TO SOME SOUTH AMERICAN ANOPLOTERMES FRITZ MÜLLER (S. S.) BASED PRIMARILY ON THE FONTANELLE

1. Fontanelle distinct 2
   Fontanelle indistinct 14
2. Fontanelle hyaline 3
   Fontanelle not hyaline 13
3. Fontanelle very large (0.25 mm. in length, 0.20 mm. in width) grandifons Snyder
   Fontanelle large, oval, raised 4
   Fontanelle large, heart shaped ..... turricola Silvestri
   Fontanelle large, suboval, wide 5
   Fontanelle small, subelliptical, narrow 8
4. Winged adults large (16.50 mm. in length) ..... pacificus Fritz Müller
   Winged adults small (11.50 mm. in length) ..... rotundus Snyder
5. Winged adults very large (24 mm. in length) ..... cingulatus Silvestri
   Winged adults large (17 mm. in length) ..... abbreviatus Silvestri
   Winged adults small 6
6. Head broad (1.30 mm. in width) ..... punctatus Snyder
   Head narrower 7

7. Eye large, mandible elongate ..... nigropunctatus Emerson
   Eye small, mandible not elongate ..... bolivianus Snyder
8. Winged adults large (14 mm. in length) ..... meridianus Emerson= (*morio* Silvestri)
   Winged adults small 9
9. Post clypeus less than twice as broad as long ..... clypeatus Snyder
   Post clypeus slightly over twice as broad as long 10
   Post clypeus nearly, or three times as broad as long 12
10. Mandibles elongate, ocellus distant from eye ..... distans Snyder
    Mandibles short, ocellus close to eye 11
11. Winged adult 10.25 mm. in length ..... distinctus Snyder
    Winged adult 9 mm. in length ..... banksi Emerson
12. Head 0.75 mm. in width ..... proximus Snyder
    Head 0.60 ..... linearis Snyder
13. Fontanelle, large suboval plate .....
    Antenna with third segment elongate ..... silvestrii Emerson
    Antenna with third segment not elongate ..... howardi Snyder
14. Length of winged adult 10 mm ..... indistinctus Snyder
    Length of winged adult 7 mm ..... brevipilis Emerson

ANOPLOTERMES (ANOPLOTERMES) BOLIVIANUS, new species

Winged, female adult.—Head castaneous-brown, broader than long (posterior margin to base of post clypeus), with dense long hairs. Fontanelle hyaline, prominent, subelliptical slit on vertex of head.

Eye black, not quite round, small but projecting, close to lateral margin of head. Ocellus hyaline, suboval, upper rim projecting, separated from eye by a distance less than the small diameter of an ocellus.

Post clypeus yellow-brown, projecting, bilobed, slightly over twice as broad as long, with dense long hairs.

Mandibles yellow to castaneous, not very elongate.

Antenna yellow-brown, 15 segments, with long hairs; third segment narrower and shorter than second or fourth segments; fourth shorter than second segment; segments become longer and broader toward apex; last segment narrow, elongate, and subelliptical.

Pronotum much lighter colored than head, yellow-brown, slightly narrower than head, saddle-shaped, sides roundly slope to posterior margin which is nearly straight, but pronotum as a whole is semicircular.

Mesonotum and metanotum are deeply and angularly emarginate.

Wings gray, costal area golden yellow-brown, tissue finely punctate, margins ciliate. In fore wing median vein nearer to cubitus than to subcosta, with branches or not to apex of wing; cubitus does not quite reach apex with 10–12 branches or subbranches to lower margin of wing.

Legs yellowish with tinge of brown, slender, elongate, with long hairs.

Abdomen with tergites castaneous, with dense long hairs; cerci not prominent.

Measurements.—

Length of entire winged adult, 11–12 mm.
Length of entire deälated adult, 7.00 mm.
Length of head (to tip labrum), 1.10 mm.
Length of left mandible, 0.50 mm.
Length of pronotum, 0.50 mm.
Length of hind tibia, 0.85 mm.
Length of anterior wing, 9.50 mm.
Diameter of eye (long diam.), 0.20 mm.
Width of head, 0.95 mm.
Width of pronotum, 0.90 mm.
Width of anterior wing, 2.60 mm.

A. (*A.*) *bolivianus* Snyder is close to *A.* (*A.*) *gracilis* Snyder, except that the latter has an indistinct fontanelle and a narrower head.

Type locality.—Tumupasa, Bolivia.

Described from three female adults collected at the type locality in December with workers and male winged adults and workers of *Anoplotermes* (*A.*) *indistinctus* Snyder; two other female winged adults, topotypes; other localities are—Rosario, Bolivia, March, 1922, deälated female adult with *A. indistinctus* Snyder deälated male adult; also Rosario, October, 1921, deälated female adults.

Type, female winged adult.—Cat. No. 27662, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) CLYPEATUS, new species

Winged, female adult.—Head dark castaneous-brown, wider than long (posterior to base of postclypeus), with dense fairly long hairs. Fontanelle a small hyaline subelliptical spot on vertex of head.

Postclypeus yellow brown, bilobed, projecting, less than twice as broad as long, with long hairs.

Eye black, not round, projecting, near lateral margin of head. Ocellus hyaline, suboval, with projecting upper rim, separated from the eye by a distance less than the small diameter of an ocellus, at oblique angle to eye.

Mandible yellow-brown, castaneous at apex, not long.

Antenna yellow-brown, 15 segments, segments becoming longer and broader toward apex, with long hairs; third segment short, narrow, and ring-like, shorter than second or fourth segments; fourth segment shorter than second; last segment elongate, slender, and subelliptical.

Pronotum light yellow-brown, saddle-shaped, subcordate, with T-shaped marking and long hairs.

Meso- and meta-nota with posterior margin deeply and roundedly emarginate.

Wings cloudy gray, costal area yellow brown, surface punctate, with hairs, margins ciliate. Forewing with median vein close to cubitus not branched or with two branches to apex of wing; cubitus with 10–11 branches or subbranches to lower margin of wing does not reach apex; in some wings median vein emerges (loops down) from subcosta at apical two-thirds of wing with two branches to apex, in others, in addition to the two branches to the apex, with two additional branches to the lower margin of the wing—venation inclined to be abnormal.

Legs yellow with brown tinge, with long hairs.

Abdomen with tergites dark castaneous-brown, with dark spiracular markings and dense long hairs; cerci not prominent.

Measurements.—

Length of entire winged adult, 10.50–11.00 mm.
Length of entire deälated adult, 5.50–6.00 mm.
Length of head (to tip of labrum), 1.10 mm.
Length of left mandible, 0.45 mm.
Length of pronotum, 0.50 mm.
Length of hind tibia, 0.75 mm.
Length of anterior wing, 9.00 mm.
Diameter of eye (long diameter), 0.20 mm.
Width of head (at eyes), 0.80 mm.
Width of pronotum, 0.65.
Width of anterior wing, 2.60.

Type locality.—San Gregorio, Beni, Bolivia.

A distinctive character is the long clypeus.

Described from a series of winged male and female adults collected with workers at the type locality by Dr. W. M. Mann in October, 1921.

Type, winged, female adult.—Cat. No. 27669, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) DISTANS, new species

Queen (first form).—Head light castaneous-brown with reddish tinge, broader than long (posterior to base of postclypeus) with dense long hairs. Fontanelle hyaline a subelliptical spot on vertex of head.

Postclypeus light yellow-brown, a little over twice as broad as long, projecting, bilobed, with long hairs.

Eye black, nearly round, close to lateral margin of head, projecting. Ocellus hyaline, oblong, separated from eye by a distance nearly equal to the long diameter of an ocellus, with projecting upper rim, set obliquely to eye.

Mandible yellow, apex castaneous, elongate.

Antenna yellow tinged with brown, 15 segments, becoming longer and broader toward apex, with long hairs; third segment short nar-

row, ring-like, shorter than fourth or second segments; fourth not quite as long as second; last segment slender, elongate and subelliptical.

Pronotum light yellow-brown, saddle-shaped, subcordate, emarginate posteriorly, with long hairs.

Meso- and meta-nota deeply and angularly emarginate.

Legs yellowish, with long hairs.

Abdomen with tergites yellow-brown tinged with gray, with faint spiracular markings and dense long hairs; cerci not prominent.

Measurements.—

Length of entire queen, 14.00 mm.
Length of head (to tip labrum), 1.00 mm.
Length of pronotum, 0.50 mm.
Length of left mandible, 0.55 mm.
Length of hind tibia, 0.80 mm.
Diameter of eye (long diameter), 0.20 mm.
Width of abdomen of queen, 2.00 mm.
Width of head, 0.85 mm.
Width of pronotum, 0.75 mm.

A. (A.) distans Snyder has a smaller eye than *A. (A.) gracilis* Snyder and, unlike the latter species, a distinct fontanelle.

Type locality.—Rosario, Bolivia.

Described from a first form queen collected with workers in November at the type locality by W. M. Mann.

Type, first form queen.—Cat. No. 27663, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) DISTINCTUS, new species

Winged, female adult.—Head castaneous-brown, broader than long (posterior to base of postclypeus) with dense long hairs. Fontanelle hyaline, a distinct suboval spot in a depression at vertex of head. Postclypeus light yellow-brown tinged with gray, bilobed, projecting, twice as broad as long, with long hairs.

Eye black not round, large, projecting, close to lateral margin of head. Ocellus hyaline, oblong, with projecting upper rim, close and at an oblique angle to eye, separated from eye by a distance less than the short diameter of an ocellus.

Mandible yellow, apex castaneous, relatively long.

Antenna light yellow-brown, 15 segments, becoming broader and longer toward apex, with long hairs; third segment short and narrow, ring-like, shorter than fourth or second segments; fourth shorter than second segment; last elongate, slender and subelliptical.

Pronotum light yellow-brown, tinged with gray, saddle-shaped, semicircular, with long hairs.

Meso- and meta-nota broadly and deeply emarginate.

Wings smoky-gray, costal area yellow-brown, margins ciliate, surface punctate and with hairs. Forewing with median vein slightly nearer cubitus than subcosta unbranched with two—three branches to apex of wing or also with three branches to lower margin in addition; cubitus with 9–12 branches or sub-branches to lower margin of wing, occupies but little of wing area (in width).

Legs yellow with tinge of brown, with long hairs.

Abdomen with tergites light castaneous-brown tinged with gray, with spiracular markings and dense long hairs; cerci fairly prominent.

Measurements.—

Length of entire winged female adult, 9.80–10.25 mm.
Length of entire winged male adult, 9.00–9.50 mm.
Length of entire deälated female, 6.50–6.75 mm.
Length of entire deälated male, 6.00—6.25 mm.
Length of head (to tip of labrum), 1.10 mm.
Length of left mandible, 0.45 mm.
Length of pronotum, 0.45 mm.
Length of hind tibia, 0.80 mm.
Length of anterior wing of female, 8.25 mm.
Diameter of eye (long diameter), 0.25 mm.
Width of head (at eyes), 0.85 mm.
Width of pronotum, 0.70 mm.
Width of anterior wing of female, 2.30 mm.

Type locality.—Rurrenabaque, Bolivia.

Described from a series of winged female and male adults collected at the type locality in October, 1921, by W. M. Mann.

Type, winged female adult.—Cat. No. 27664, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) GRANDIFONS, new species

Deälated, female adult.—Head dark castaneous-brown, broader than long (posterior to base of postclypeus), with dense long hairs and shorter hairs. Fontanelle a very prominent hyaline oblong depression, slightly on a bias, 0.25 mm. in length and 0.20 mm. in width (pl. 1, fig. 3).

Eye black, nearly round, large, prominent and projecting, close to lateral margin of head. Ocellus hyaline, suboval, with projecting upper rim, separated from the eye by a distance equal to its short diameter.

Postclypeus light castaneous, bilobed, projecting, slightly over twice as broad as long, with long hairs.

Mandibles yellow to castaneous at apex, elongate.

Antenna yellow brown, 15 segments, with long hairs; third segment shorter than second or fourth segments, narrow, ring-like; fourth shorter than second segment; segments become longer and broader toward apex; last segment narrow, slender, sub-elliptical.

Pronotum slightly lighter colored than head, saddle-shaped, not twice as broad as long, sides angularly but broadly narrowed to posterior margin, with dense long and short hairs.

Meso- and meta-nota deeply, broadly and roundly emarginate.

Legs yellow with tinge of brown dorsally, with long hairs.

Abdomen with tergites dark castaneous-brown, with dense hairs; cerci not prominent.

Measurements.—

Length of entire deälated adult, 9.00 mm.
Length of head (to tip of labrum), 1.60 mm.
Length of left mandible, 0.80 mm.
Length of pronotum, 0.70 mm.
Length of hind tibia, 1.60 mm.
Diameter of eye (long diameter), 0.35 mm.
Width of head (at eyes), 1.40 mm.
Width of pronotum, 1.20 mm.

Type locality.—Rosario, Bolivia.

Described from a single female deälated adult collected in termite hills in November, 1921, by Dr. W. M. Mann with *Anoplotermes* (*A.*) *pacificus* Fritz Müller.

Type, deälated, female adult.—Cat. No. 27665, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) HOWARDI, new species

Deälated, male adult.—Head dark castaneous-brown, broader than long (posterior to base of postclypeus), with dense long and shorter hairs. Fontanelle indistinct, a large oval plate in depression on vertex of head.

Postclypeus dark castaneous-brown, slightly lighter colored than head, over twice as broad as long, bilobed, projecting with long hairs.

Eye black, not round, large, projecting, close to lateral margin of head. Ocellus hyaline, suboval, separated from eye by a distance equal to its short diameter, with projecting upper rim, at angle to eye.

Mandible yellow-brown, apex castaneous, elongate.

Antenna yellow-brown, 15 segments, becoming longer and broader toward apex, with long hairs; third segment ring-like, narrower and much shorter than second and slightly shorter than fourth segment; fourth shorter than second segment; last segment elongate, slender, and subelliptical.

Pronotum dark castaneous-brown, slightly lighter colored than head, saddle-shaped, sides angularly rounded to posterior margin, with long hairs, pronotum shorter than in *A. grandifons* Snyder and sides not so broadly rounded to posterior.

Meso- and meta-nota deeply and angularly emarginate posteriorly; in *A.* (*A.*) *grandifons* Snyder more broadly roundedly emarginate.

Legs brownish, with long hairs.

Abdomen with tergites dark castaneous-brown, with faint spiracular markings and dense long hairs; cerci fairly prominent.

Measurements.—

Length of entire deälated male adult, 9.50 mm.
Length of head (to tip labrum), 1.60 mm.
Length of left mandible, 0.80 mm.
Length of pronotum, 0.75 mm.
Length of hind tibia, 1.60 mm.
Diameter of eye (long diameter), 0.35 mm.
Width of head (at eyes), 1.45 mm.
Width of pronotum, 1.30 mm.

A. (*A.*) *howardi* Snyder is close to *A.* (*A.*) *grandifons* Snyder except for the latter's prominent fontanelle, larger pronotum and more broadly and roundedly emarginate posterior of the meso- and meta-nota. This termite was named in honor of Dr. L. O. Howard, Chief of the Bureau of Entomology, United States Department of Agriculture, who has published several articles on termites and has always been keenly interested in their biology.

Type locality.—Rosario, Bolivia.

Described from three deälated male adults collected at the type locality in November, 1921 by W. M. Mann.

Type, deälated, male adult.—Cat. No. 27666, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) INDISTINCTUS, new species

Winged, male adult.—Head castaneous-brown (with reddish tinge), broader than long (posterior to base of post.clypeus), with dense long hairs. Fontanelle indistinct raised spot in a broad depression on vertex of head.

Eye black, small, nearly round, projecting, and prominent, near lower margin of head. Ocellus hyaline, oblong, with projecting upper rim, separated from eye by a distance less than the small diameter of an ocellus.

Post clypeus yellow-brown, projecting, bilobed, slightly over twice as broad as long, with dense long hairs.

Mandibles yellow to castaneous, elongate.

Antenna yellow-brown, 15 segments, with long hairs; third segment small, ring-like, shorter and narrower than second or fourth segments; fourth segment only half as long as second; segments become longer and broader toward apex; last segment elongate, narrow and subelliptical, pointed at apex.

Pronotum much lighter colored than head, yellow-brown, saddle-shaped, not as broad as head, nor twice as broad as long; broadly semicircular, with dense long hairs.

Mesonotum and metanotum deeply, angularly emarginate posteriorly.

Wings gray, costal veins golden yellow, tissue finely punctate, hairy, margins ciliate. Fore wing with median vein slightly nearer to cubitus than to subcostal vein, with several (3-4) branches to apex of wing: cubitus does not reach apex, with 10–11 branches or subbranches to lower margin of wing; occupies less than half the wing area in width.

Legs yellow with tinge of brown, with long hairs.

Abdomen with tergites castaneous-brown, with dense long hairs.

Measurements.—

Length of entire winged male adult, 9.50–10.00 mm.
Length of entire deälated adult, 5.50 mm.
Length of head (to tip of labrum), 1.00 mm.
Length of left mandible, 0.70 mm.
Length of pronotum, 0.45 mm.
Length of fore wing, 8.00 mm.
Length of hind tibia, 0.85 mm.
Diameter of eye (long diameter), 0.20 mm.
Width of head (at eyes), 0.85–0.90 mm.
Width of pronotum, 0.70 mm.
Width of anterior wing, 2.20 mm.

A. (*A.*) *indistinctus* Snyder is close to *A.* (*A.*) *gracilis* Snyder, which, however, has a narrower head and larger wings.

Type locality.—Tumupasa, Bolivia.

Described from three male winged adults collected with workers at the type locality in December with winged female adults of *A.* (*A.*) *bolivianus* Snyder; also a deälated male adult with *bolivianus* at Rosario, in March, 1922.

Type, winged male adult.—Cat. No. 27667, U.S.N.M.

Other localities where *A. indistinctus* was collected are:

Rosario, Bolivia, October, 1921 (winged adults and workers); Rio Negro, Bolivia, January, 1922 (queen and workers); Ivon, Bolivia, February, 1922 (two queens and workers); Ivon, Bolivia, February, 1922 (queen and workers); Ivon, Bolivia, February, 1922 (queen, king, and workers); Rosario, Bolivia, March, 1922 (deälated female adult with deälated male adult of *Anoplotermes* (*A*) *bolivianus* Snyder).

ANOPLOTERMES (ANOPLOTERMES) LINEARIS, new species

Winged, female adult.—Head light castaneous-brown tinged with gray, broader than long (posterior to base of postclypeus), with dense fairly long hairs. Fontanelle hyaline subelliptical slit on

vertex of head. Postclypeus yellow brown, bilobed, projecting, three times as broad as long.

Eye black, not round, relatively large and projecting, close to lateral margin of head. Ocellus hyaline, oblong, with projecting upper rim, relatively large, at oblique angle to and almost touching eye.

Antenna light yellow-brown, 14–15 segments, becoming longer and broader toward apex, with long hairs; third segment short narrow and ring-like, shorter than second or fourth; fourth shorter than second segment; last segment elongate, slender and subelliptical.

Mandibles yellow, apex light castaneous, short.

Pronotum yellow-brown, tinged with gray, saddle-shaped, subcordate, with long hairs.

Meso- and meta-nota deeply and roundedly emarginate.

Wings cloudy gray, costal area yellow-brown, margin ciliate, surface punctate, with hairs. In forewing median vein close to cubitus, branches (2–3 times) to apex; cubitus with 8–9 branches or subbranches to lower margin of wing.

Legs white tinged with yellow, with long hairs.

Abdomen with tergites light castaneous brown, tinged with gray, with spiracular markings and dense fairly long hair; cerci fairly prominent.

Measurements.—

Length of entire winged adult, 7.00 mm.
Length of entire deälated adult, 4.80–5.20 mm.
Length of head (to tip of labrum), 0.85 mm.
Length of left mandible, 0.31 mm.
Length of pronotum, 0.35 mm.
Length of hind tibia, 0.55 mm.
Length of anterior wing, 6.00 mm.
Diameter of eye (long diameter), 0.175 mm.
Width of head (at eyes), 0.60 mm.
Width of pronotum, 0.46 mm.
Width of anterior wing, 1.80 mm.

A. (*A.*) *linearis* Snyder is the most slender species of *Anoplotermes* known to the author.

Type locality.—Tumupasa, Bolivia.

Described from 7 male and female winged adults collected by W. M. Mann at the type locality in December, 1921.

Type, winged female adult.—Cat. No. 27668, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) PROXIMUS, new species

Winged, female adult.—Head castaneous-brown, broader than long (posterior to base of postclypeus), with dense long hairs. Fontanelle hyaline, subelliptical slit on vertex of head. Postclypeus yellow-

brown, nearly three times as broad as long, bilobed, projecting with long hairs.

Eye black, not round, relatively large, projecting, close to lateral margin of head. Ocellus hyaline, suboval, upper rim projecting, close and at an angle to eye, separated from eye by a distance less than the short diameter of an ocellus.

Mandible yellow, castaneous at apex, relatively long.

Antenna light yellow-brown, 14–15 segments, segments becoming longer and broader toward apex, with long hairs; third segment ring-like, short and narrow, shorter than second or fourth segments; fourth segment shorter than second; last segment slender, elongate, and subelliptical.

Pronotum yellow-brown, tinged with gray, lighter colored than head; saddle-shaped, broadly subcordate, with T-shaped marking and long hairs.

Meso- and meta-nota with posterior margins broadly roundedly emarginate.

Wings smoky-gray, costal area yellow-brown, margins ciliate, surface punctate and with hairs. In forewing median vein nearer to cubitus than to subcosta, with two branches to apex of wing and one or two branches to lower margin; cubitus with nine branches or subbranches to lower margin of wing, occupies less than half area of wing (in width).

Legs yellow-brown, with long hairs.

Abdomen with tergites yellow-brown tinged with gray, with spiracular markings and dense long hairs; cerci fairly prominent.

Measurements.—

Length of entire winged female adult, 8.50–8.75 mm.
Length of entire winged male adult, 7.75–8.00 mm.
Length of entire deälated female adult, 5.00–5.70 mm.
Length of entire deälated male adult, 4.50–5.30 mm.
Length of head (to tip of labrum), 0.90 mm.
Length of left mandible, 0.40 mm.
Length of pronotum, 0.45 mm.
Length of hind tibia, 0.70 mm.
Length of anterior wing of female, 7.25 mm.
Diameter of eye (long diameter), 0.20 mm.
Width of head (at eyes), 0.75 mm.
Width of pronotum, 0.60 mm.
Width of anterior wing of female, 2.10 mm.

A. (*A.*) *proximus* Snyder comes in the group where the postclypeus is over twice as broad as long.

Type locality.—Tumupasa, Bolivia.

Described from a series of winged female and male adults collected with workers at the type locality by W. M. Mann in December, 1921.

Type, winged female adult.—Cat. No. 27670, U.S.N.M.

ANOPLOTERMES (ANOPLOTERMES) PUNCTATUS, new species

Queen (*first form*).—Head dark castaneous-brown with reddish tinge, broader than long (posterior to base of clypeus), with dense long hairs. Fontanelle a hyaline, prominent, pear-shaped spot on vertex of head.

Eye black, nearly round, large, prominent, projecting, close to lateral margin of head. Ocellus hyaline, suboval, with projecting upper rim; separated from the eye by a distance nearly equal to the long diameter of an ocellus.

Post clypeus light castaneous, projecting, bilobed, twice as broad as long, with long hairs.

Mandibles yellow to castaneous at apex, elongate.

Antenna light yellow-brown, broken (12 segments), with long hairs; third segment short, narrow and ring-like, shorter than second or fourth segments; fourth only about half as long as second segment; segments become longer and broader toward apex.

Pronotum very slightly if any lighter colored than head, saddle-shaped, not as broad as head nor twice as broad as long, broadly semicircular, with dense, long hairs.

Meso- and meta-nota shallowly, angularly emarginate posteriorly.

Legs yellow with tinge of brown, with long hairs.

Abdomen with tergites dark castaneous-brown, with dense long hairs; cerci not prominent.

Measurements.—

Length of entire deälated adult, 6.00 mm.
Length of head (to tip labrum), 1.40 mm.
Length of left mandible, 0.70 mm.
Length of pronotum, 0.60 mm.
Length of hind tibia, 1.40 mm.
Diameter of eye (long diameter), 0.27 mm.
Width of head, 1.20–1.30 mm.
Width of pronotum, 1.00 mm.

A. (*A.*) *punctatus* Snyder is near *A.* (*A.*) *hondurensis* Snyder but has a prominent fontanelle; the fontanelle is not as large as in *A.* (*A.*) *rotundus* Snyder.

Type locality.—Rosario, Bolivia.

Described from a deälated male adult and queen (enlarged, first form) collected with workers at the type locality in October, 1921.

Type, deälated male adult.—Cat. No. 27671, U.S.N.M.; morphotype, queen.

ANOPLOTERMES (ANOPLOTERMES) ROTUNDUS, new species

Winged, male adult.—Head castaneous-brown, broader than long (to base of post clypeus,) with dense hairs. Fontanelle a hyaline circular prominent raised spot in an orange rimmed depression on vertex of head—not quite as large as an ocellus.

Antenna yellow, 15 segments, with dense long hairs, segments becoming longer and broader towards apex; third segment shorter than second or fourth segments; fourth shorter than second segment; last segment elongate, slender, subelliptical.

Eye black, nearly round, projecting, close to lateral margin of head. Ocellus hyaline, suboval, with projecting upper rim, separated from eye by a distance equal to its long diameter.

Post clypeus lighter colored than head (yellow-brown,) projecting, bilobed, slightly over twice as broad as long, with dense long hairs.

Mandibles yellow, castaneous at tips, elongate.

Pronotum lighter colored than head, narrower than head, saddle shaped, anterior margin straight, sides angularly slope to posterior margin which is straight, with dense long hairs.

Meso- and meta-nota with posterior margins emarginate.

Wings gray, costal area golden yellow-brown, tissue punctate, margins ciliate. In forewing median vein closer to cubitus than to sub-costa, reaches apex of wing entire or branched; cubitus does not reach apex of wing, with 10–11 branches or sub-branches to lower margin of wing, occupies less than half area of wing (in width.)

Legs yellow with tinge of brown, with long hairs.

Abdomen with tergites castaneous, with dense hairs, cerci not prominent.

Measurements.—

Length of entire winged male adult, 11.50 mm.
Length of entire deälated, 6.80 mm.
Length of head (to tip of labrum), 1.20 mm.
Length of left mandible, 0.75 mm.
Length of pronotum, 0.65 mm.
Length of hind tibia, 1.40 mm.
Length of anterior wing, 10.00 mm.
Diameter of eye (long diameter), 0.27 mm.
Width of head (at eyes), 1.25 mm.
Width of pronotum, 1.10 mm.
Width of anterior wing, 2.60 mm.

A. (*A.*) *rotundus* Snyder is distinctive due to the prominent circular fontanelle; otherwise it is close to *A.* (*A.*) *hondurensis* Snyder.

Type locality.—Rosario, Bolivia.

Described from two male winged adults collected with workers at the type locality in November, 1921, with *Anoplotermes* (*A.*) *pacificus* Fritz Müller (winged and workers) and *Capritermes* (*Neocapritermes*) *parallelus* Snyder (soldiers and workers).

Type, winged male adult.—Cat. No. 27672, U.S.N.M.

The following described species of *Anoplotermes* were also collected:

ANOPLOTERMES (ANOPLOTERMES) NIGROPUNCTATUS Emerson

Tumupasa, Bolivia, December, 1921 (winged adults and workers with soldiers of *Leucotermes tenuis* Hagen).

ANOPLOTERMES (ANOPLOTERMES) PACIFICUS Fritz Müller

Rosario, (Lake Rogagua) Bolivia, November, 1921 (winged adults and workers in hills); Rosario, Bolivia, November, 1921 (deälated adults and workers with winged adults and soldiers of *Leucotermes tenuis* Hagen); Rosario, Bolivia, November, 1921 (winged adults and workers with soldiers and workers of *C. (Neocapritermes) parallelus* Snyder and winged adults and workers of *Anoplotermes* (*A.*) *rotundus* Snyder.)

ANOPLOTERMES (SPECULITERMES), species

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (workers only, from earth nest in crotch of tree near the ground); Cachuela Esperanza, Beni, Bolivia (workers).

Genus CYLINDROTERMES Holmgren

The genus *Cylindrotermes* includes but the single species *nordenskiöldi* Holmgren, described from soldiers and workers collected only once by Holmgren in the stump of a banana tree at Tuiche, Province de Caupolican, Bolivia, May, 1904 (Holmgren, 1906). This genus comes in the *Amitermes* group and is near the genus *Cephalotermes* Silvestri, according to Holmgren (1912).

A new species from Bolivia, *C. brevipilosus*, is herewith described; it is close to *nordenskiöldi* Holmgren but is strikingly characterized by dense short hairs on the head of the soldier.

Species collected by A. Emerson at Kartabo, British Guiana, and determined by Emerson as *nordenskiöldi* may be a new species. Specimens from Barro Colorado Island, Canal Zone, and Rio Chinilla, Canal Zone, Panama, appear to be nearer to Holmgren's type; the head is broader than Emerson's specimens and the mandibles longer and stouter; antennae and pubescence similar.

CYLINDROTERMES BREVIPILOSUS, new species

Soldier.—Head straw-yellow, elongate, sides nearly parallel, narrowed towards posterior, with dense short hairs (but few long hairs); mandibles black with reddish tinge, stout, base yellow-brown, short and curved. The width of the gula at the middle is more than half the width at the front. The labrum is of different shape than in *nordenskiöldi*.

Antenna light yellow, 11 to 12 segments, pubescent; if 12 segments, third segment indistinct, very small; fourth shorter than second

or fifth; in specimens of *C. nordenskiöldi* Holmgren from British Guiana there are plainly 12 segments to the antennae.

Pronotum pale yellow, saddle-shaped, with fairly large, raised up front, anterior margin *not* emarginate (pl. 1, fig. 7).

A comparison was made of one soldier and workers of *brevipilosus* collected by W. M. Mann at Ivon, Bolivia, in February 1922, and soldiers and workers of *nordenskiöldi* ? collected at Kartabo, British Guiana, by Alfred Emerson. The soldier of *brevipilosus* is smaller, has denser, shorter hairs on the head, and shorter, more curved mandibles. A larger portion of the pronotum is raised up and the anterior margin is not emarginate, as is the case in the soldiers of *nordenskiöldi* from Kartabo and Holmgren's description of the type (Holmgren, 1906); the description of the type also states that the head is fairly thickly pubescent; the specimens of *nordenskiöldi* ? from Kartabo have a narrower head than Holmgren's type and may be a new species. Specimens from Panama seem to be nearer to Holmgren's type. The following measurements show these differences:

Measurements [1]	*Cylindrotermes brevipilosus* Snyder *Ivon, Bolivia*	*Cylindrotermes nordenskiöldi* Holmgren *Kartabo, B. G.*	*Cylindrotermes nordenskiöldi* Holmgren *Barro, Colorado Island, Panama*	*Cylindrotermes nordenskiöldi* Holmgren *Tuiche, Bolivia*
	Mm.	*Mm.*	*Mm.*	*Mm.*
Length of entire soldier	3. 90	4. 60	4. 20–4. 60	3. 90
Length of head with mandibles	2. 10	2. 10–2. 2	2. 25–2. 35	2. 0
Length of head without mandibles (to anterior)	1. 50	1. 55–1. 60	1. 70–1. 75	
Length of left mandible	. 65	. 62– . 67	. 80	
Length of pronotum	. 32	. 35– . 37	. 40	. 45
Length of hind tibia	. 57	. 55	. 70	
Width of head	. 80	. 80– . 85	. 95–1. 0	. 90
Width of pronotum	. 55	. 58– . 60	. 65	. 70
Length of entire worker	3. 0 –3. 7	3. 6 –3. 9	3. 10–3. 50	3. 8
Length of head	. 9 –1. 1	. 9 –1. 05	. 90– . 95	1. 0
Width of head	. 75– . 85	. 65– . 75	. 85– . 90	. 9
Length of antennae	. 85– . 95	. 80– . 90	. 90	1. 0
Width of abdomen	. 70– . 95	. 70– . 90	1. 10	1. 2

[1] The worker of *brevipilosus* has denser, longer hairs; both species have 13 segments to the antenna.

Type locality.—Ivon, Bolivia. Described from a single soldier and several workers collected by W. M. Mann, in February, 1922, at the type locality.

Type, soldier.—Cat. No. 27673, U.S.N.M.

Genus MIROTERMES Wasmann

In 1912, Holmgren divided the genus *Mirotermes* Wasmann into several subgenera. Of these subgenera, two were found in Bolivia by Doctor Mann, namely *Mirotermes* (*sensu strictore*) Holmgren and

Spinitermes Wasmann. Soldiers of species of *Mirotermes* flip or snap particles of earth with their elongate mandibles and this method of defense is very effective against ants, etc. Species in this subgenus are widely distributed throughout the world (in the Southern Hemisphere); only six species have been described from America. Only one species (and this new to science) was found in Bolivia.

MIROTERMES (MIROTERMES) BOLIVIANUS, new species

Soldier.—Head yellowish, darker anteriorly, narrow, slightly broader anteriorly, sides nearly parallel (slightly concave in middle), broadly rounded posteriorly, truncate anteriorly, an elongate, triangular median frontal process, with pointed upturned tip, markings at base differ from those in *panamaensis* Snyder, head with scattered, fairly long hairs, dense on apex of frontal process.

Labrum white with tinge of yellow, elongate, narrow, concave at middle, with two lateral elongate slender pointed lobes, with long hairs.

Mandibles black, elongate, slender, bowed, incurved at apex, left mandible finely roughened (serrate) at inner margin near apex (as is *M.* (*M.*) *panamaensis* Snyder).

Antenna light yellow-brown, 14 segments, pubescent; second segment longer than third which is longer than fourth; from fifth on, segments become longer and broader toward apex; last segment elongate, slender and pointed at tip.

Pronotum white, tinged with yellow, saddle-shaped, slightly emarginate anteriorly and posteriorly, short, sides slope markedly to posterior margin, with long hairs.

Legs white, tinged with yellow, claws brown, elongate, slender, pubescent.

Abdomen dirty-gray-white tinged with yellow, with dense short hairs and row of longer hairs at base each tergite; cerci fairly prominent.

Measurements.—

Length of entire soldier, 4.90 mm.
Length of head with mandibles, 3.20 mm.
Length of head to anterior, 1.70 mm.
Length of left mandible, 1.75 mm.
Length of pronotum, 0.30 mm.
Length of hind tibia, 0.80 mm.
Width of head anteriorly, 0.90 mm.
Width of head posteriorly, 0.80 mm.
Width of pronotum, 0.55 mm.

The soldier of *Mirotermes* (*M.*) *bolivianus* Snyder has a narrower head and a longer and more pointed frontal process than *M.* (*M.*) *panamaensis* Snyder and *hispaniolae* Banks (which is nar-

rower headed than *panamaensis*) ; *bolivianus* has a longer, narrower head than *nigritus* Silvestri, and a longer and more robust frontal process.

Type locality.—Ivon, Bolivia.

Described from a series of soldiers and workers collected at the type locality in March, 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27677, U.S.N.M.

Subgenus SPINITERMES Wasmann

This subgenus of *Mirotermes* Wasmann is restricted to South America; only four species have as yet been described. Holmgren found one species of *Mirotermes* and two species of *Spinitermes* on the Nordenskiöldi Expedition—all being new. Mann found only one species of *Mirotermes* and but one new and two known species of *Spinitermes* in Bolivia on the Mulford Expedition. Specific characters are found in the remarkable three-pointed frontal process (fig. 2).

MIROTERMES (SPINITERMES) BREVICORNUTUS Holmgren

Soldier (fig. 2*b*).—Head yellow, paler posteriorly, sides nearly parallel, slightly narrowed anteriorly, central anterior point much larger and more robust than two lateral, small, robust points, forms an acute angle with head, wrinkled and slightly upturned at pointed apex, head with sparse short hairs and scattered long hairs, central and lateral points with dense, long hairs.

Labrum yellow, longer than broad, two lateral points hyaline, elongate, pointed; center not markedly convex, as in *robustus* Snyder, with long hairs.

Gula narrow, more than twice as wide at front as at center.

Mandibles black with reddish tinge, elongate, slender, slightly bowed and incurved at tips.

Antenna white with tinge of yellow, 14 segments, pubescent; third segment shorter than second, approximately the same size as the fourth segment (slightly longer), fifth longer (in the type of *M.* (*S.*) *trispinosus* Hagen,[12] the third segment is shorter than the second but longer than the fourth); eleventh to fourteenth slightly shorter and slenderer; last segment slender and pointed at tip.

Pronotum pale yellow, saddle-shaped, anterior very high, anterior margin emarginate, with short and long hairs.

Legs white with tinge of yellow, pubescent.

Abdomen gray with tinge of yellow, with very dense short hairs and two long hairs at base of each tergite, dense long hairs at end abdomen.

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[12] Emerson's specimens of *trispinosus* from British Guiana have the fourth segment longer than the second or third segments and narrower head; they probably represent a new species.

Measurements.—

Length of entire soldier (to tip of mandibles) 6.30 mm.
Length of entire soldier (to central point), 2.40 mm.
Length of head with mandibles, 3.10 mm.
Length of head (to tip of central point), 2.35 mm.
Length of head without mandibles (to tip of labrum), 2.35–2.40 mm.
Length of head without mandibles (to anterior), 2.00 mm.
Length of central spine, 0.45 mm.
Length of left mandible, 1.70 mm.
Length of pronotum, 0.30 mm.
Length of hind tibia, 1.00 mm.
Width of head (at posterior), 1.25–1.35 mm.
Width of pronotum, 0.75 mm.

Lighter colored and with the two lateral points slightly more robust and the central point less robust than in a soldier of *M.* (*S.*) *brevicornutus* from Coxipo, Cuyabà; head and central point longer than in *robustus* Snyder; head narrower than that of *trispinosus*

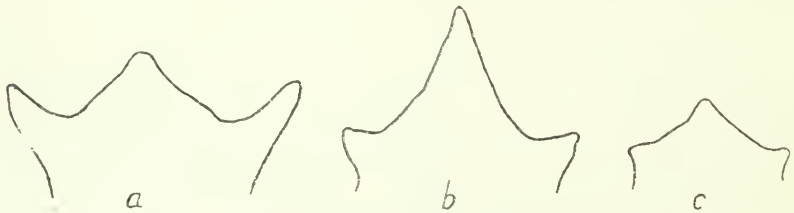


FIG. 2.—CONTRASTING DORSAL VIEWS OF THREE FRONTAL PROCESSES ON HEADS OF SOLDIERS OF THREE AMERICAN SPINITERMES; NOTE THAT THE PROCESSES ARE SLIGHTLY ASYMMETRICAL *a*. SOLDIER OF MIROTERMES (SPINITERMES) ROBUSTUS SNYDER. (IXIAMAS, BOLIVIA, DECEMBER, 1921.) *b*. SOLDIER OF MIROTERMES (SPINITERMES) BREVICORNUTUS HOLMGREN. (ROSARIO, BOLIVIA, NOVEMBER, 1921.) *c*. SOLDIER OF MIROTERMES (SPINITERMES) TRISPINOUS HAGEN. (CACHUELA ESPERANZA, BENI RIVER, BOLIVIA, MARCH, 1922.) (FIGS. 3*a*, *b*, AND *c* CAMERA LUCIDA, ALL DRAWN TO THE SAME SCALE)

Hagen (pl. 2, figs. 3 and 6), and head and central point longer (compared with type) (fig. 2*c*); head wider than in *nigrostomus* Holmgren; mandibles larger than in *gracilis* Holmgren—where the anterior middle of the labrum is concave.

Described from two soldiers collected with workers at Rosario, Bolivia, in November, 1921, by W. M. Mann (No. 5). These soldiers may represent a new species which is close to *S. brevicornutus* Holmgren.

MIROTERMES (SPINITERMES) ROBUSTUS, new species

Soldier (fig. 2*a*).—Head yellow-brown, darker anteriorly, robust, narrowed toward anterior margin, three elongate and robust blunt points at anterior margin, the two lateral points are elongate and approach the central point in size as in *M.* (*S.*) *trispinosus* Hagen; the central point forms an acute angle with the head; head with sparse short hairs and a few longer hairs, anterior points with dense long hairs.

Labrum yellow-brown, elongate, longer than broad, two lateral points hyaline, elongate, slender, labrum convex in center, with long hairs.

Gula broad in middle, more than half width at front.

Mandibles black, elongate, slender, slightly bowed and incurved at apex, longer than width of head.

Antenna yellow-brown, 14 segments, pubescent; third segment subclavate, shorter than second or fourth, from fifth to ninth longer, toward apex (10–14) segments shorter and narrower, last segment pointed at tip.

Pronotum white with tinge of yellow, saddle-shaped, with a few long and short hairs, emarginate anteriorly (hardly emarginate in *trispinosus* Hagen).

Legs white with tinge of yellow, pubescent.

Abdomen dirty-gray with tinge of yellow, with dense short hairs, longer hairs toward end and on sternites.

Measurements.—

Length of entire soldier (to tip of mandibles), probably 6.0(?) mm. (5.25 mm. with mandibles closed.)
Length of entire soldier (to tip of central point), 5.2 mm.
Length of head with mandibles, 3.1 mm.
Length of head (to tip of central point), 2.05 mm.
Length of head without mandibles (to tip of labrum), 2.20 mm.
Length of head (to anterior) : 1.60 mm.
Length of central spine, 0.40 mm.
Length of left mandible, 1.70 mm.
Length of pronotum, 0.25 mm.
Length of hind tibia, 0.95 mm.
Width of head (at posterior), 1.50 mm.
Width of pronotum, 0.80 mm.

Close to *trispinosus* (compared with type), head wider but shorter than in *trispinosus*, hind tibiae shorter; smaller than *brevicornutus* Holmgren (= *brevicornis* Silvestri), the anterior points more robust, central point forms more of an angle to the head; head wider than in *nigrostomus* Holmgren; head wider and mandibles longer than in *gracilis* Holmgren, where labrum is concave in center.

Type locality.—Ixiamas, Bolivia.

Described from two soldiers collected with workers at the type locality in December, 1921, by W. M. Mann; soldiers and workers of *Armitermes* (*Curvitermes*) *odontognathus* Silvestri were collected with these soldiers.

Type, soldier.—Cat. No. 27678, U.S.N.M.

The described species of *Spinitermes* collected by Mann on the Mulford expedition is *Mirotermes* (*Spinitermes*) *trispinosus* Hagen found at Cavinas, Bolivia, February, 1922 (soldier with *Corni-*

termes, species); Cachuela[13] Esperanza (Beni River), Bolivia, March, 1922 (soldier with *Cornitermes* (*Labiotermes*) *labralis* Holmgren).

Subgenus NEOCAPRITERMES Holmgren

This subgenus of the genus *Capritermes* Wasmann was established by Holmgren in 1912; all the contained species are from America, except one from Africa (namely *N. alienus* Von Rosen).

In *Neocapritermes* the winged adult has the first tooth of the mandibles not larger than the second; antennae with 17 segments; meso- and meta-notum broad posteriorly, radius of fore wing present; the soldier lacks the fontanelle.

In *Capritermes* (*sensu strictore*) Wasmann the winged adult has the first tooth of the mandibles larger than the second; antennae 14–15 segments; meso- and meta-nota strongly narrowed posteriorly; radius lacking; the soldier has the fontanelle present.

Eight species of *Neocapritermes* have been previously described from America.

The asymmetrical mandibles are used in flipping themselves away from enemies, or snapping particles of earth! *Mirotermes* Wasmann has the same habit, and this is an effective method of defense against ants, etc. *N. planiceps* Emerson, a remarkable flat-headed species described from British Guiana, has been found in Bolivia by Doctor Mann.

CAPRITERMES (NEOCAPRITERMES) BRAZILIENSIS, new species

Soldier (fig. 3*c*).—Head light yellow-brown, light castaneous-brown anteriorly, distinct longitudinal median line reddish-brown, narrow, sides nearly parallel, slightly convex, head slightly depressed at center; frontal gland white, elongate, sub-oval depression between epicranial suture and longitudinal median line; with short and scattered long hairs. Mandibles black, reddish brown at bases, elongate, twisted asymmetrically and left mandible longer than right. Labrum yellow-brown, trilobed at apex, twisted to follow curving of mandibles.

Antenna dark yellow-brown, 15 segments, pubescent; third segment more deeply colored and wider than adjacent segments, bead-like; second cylindrical, longer than third; fourth subclavate about same length as second; segments 7–12 elongate; last segment elongate, slender and pointed at apex.

Pronotum light yellowish, margins darker, saddle-shaped with long hairs.

[13] With smaller lateral spines or points than in the specimen from Cavinas; may be a new species.

Legs pale yellowish, tibiae darker, elongate, slender, pubescent. Abdomen dirty gray, with tinge of yellow, with dense long yellow-brown hairs.

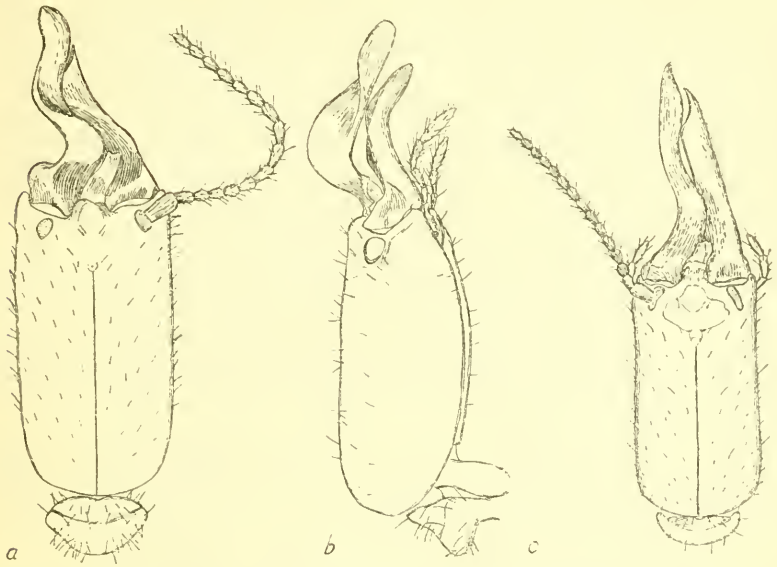


FIG. 3.—CONTRASTING VIEWS OF SOLDIERS OF NEW NEOCAPRITERMES. *a*. DORSAL VIEW OF HEAD AND PRONOTUM OF THE SOLDIER OF CAPRITERMES (NEOCAPRITERMES) HOPKINSI SNYDER SHOWING TWISTED MANDIBLES. *b*. LATERAL VIEW OF HEAD AND PRONOTUM OF THE SOLDIER OF CAPRITERMES (NEOCAPRITERMES) HOPKINSI SNYDER SHOWING TWISTED MANDIBLES. *c*. DORSAL VIEW OF HEAD AND PRONOTUM OF THE SOLDIER OF CAPRITERMES (NEOCAPRITERMES) BRAZILIENSIS SNYDER; NOTE NARROW HEAD AND TWISTED MANDIBLES

Measurements.—

Length of entire soldier, 8.25–8.50 mm.
Length of head with mandibles, 5.50–5.60 mm.
Length of head without mandibles (to anterior), 2.85–3.00 mm.
Length of left mandible, 2.60–2.80 mm.
Length of pronotum, 0.55 mm.
Length of hind tibia, 1.35–1.40 mm.
Width of head, 1.50–1.60 mm.
Width of pronotum, 0.90–0.95 mm.

C. (*N.*) *angusticeps* Emerson is larger than *braziliensis* Snyder, has a wider head and a bilobed labrum; *braziliensis* differs from *C.* (*N.*) *opacus*, subspecies *parvus* Silvestri in having a longer head and longer mandibles, in pubescence on head, and only has 15 segments to antennae, whereas *parvus* has 16 segments.

Type locality.—Rio Mautania, Brazil.

Described from four soldiers collected with workers at the type locality in March, 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27634, U.S.N.M.

CAPRITERMES (NEOCAPRITERMES) HOPKINSI, new species

Soldier (figs. 3 *a* and *b*).—Head light yellow-brown, with reddish-brown tinge anteriorly, sides head not parallel but head broader anteriorly than posteriorly, pale reddish-brown longitudinal median line ends at frontal gland which is a pale reddish-brown point at the apex of the epicranial suture, head with scattered long hairs, most numerous anteriorly. Mandibles black, relatively short and broad, bowed and bent downward at about middle, asymmetrical, left longer than right. Labrum light yellow-brown, elongate, narrowed toward apex and bilobed—middle of apex concave and sides prolonged into points. The gula is slender at the middle.

Antenna dark yellow-brown, 16 segments, pubescent; third segment shorter than second or fourth segments, third and fourth being bead-like; fifth segment broader and longer than fourth; from sixth segment to twelfth segments become longer and broader and are subclavate; segments thirteenth to sixteenth narrower and shorter; last segment pointed at apex.

Pronotum light yellow, darker at margins, saddle-shaped, markedly emarginate anteriorly and slightly posteriorly, anterior margin not steeply raised up, with long hairs.

Legs with yellowish tinge, elongate, slender, pubescent.

Abdomen dirty gray with tinge of yellow, with reddish-brown, dense, long hairs.

Measurements.—

Length of entire soldier, 9.75–10.25 mm.
Length of head with mandibles, 5.5–6.0 mm.
Length of head without mandibles (to anterior), 3.55–3.6 mm.
Length of left mandible, 2.25 mm.
Length of hind tibia, 1.45–1.50 mm.
Length of pronotum, 0.75 mm.
Width of head at anterior (where broadest), 1.90 mm.
Width of head at posterior, 1.65–1.70 mm.
Width of pronotum, 1.10 mm.

C. hopkinsi is close to *C.* (*N.*) *talpa* Holmgren but differs from the description in larger size, in not having sides of head parallel, relatively longer mandibles, fourth segment of antennae much smaller than second, and emarginate anterior margin of pronotum. Named in honor of Dr. A. D. Hopkins, Forest Entomologist of the Bureau of Entomology since 1902.

Type locality.—Ivon, Bolivia.

Described from two soldiers collected with workers at the type locality in February 1922, by W. M. Mann.

Type, soldier.—Cat. No. 27675, U.S.N.M.

CAPRITERMES (NEOCAPRITERMES) PARALLELUS, new species

Winged, female adult.—Head fuliginous (dark brown with a little black), longer than broad, rounded posteriorly; epicranial suture depression on frontal slope; with a few scattered long hairs. Fontanelle a black, raised, round spot, larger than an ocellus, center hyaline. Eye blackish, not round, large and projecting, very near lateral margin of head. Ocellus hyaline, elongate, upper rim projecting, separated from eye by a distance greater than the small diameter of an ocellus.

Post-clypeus slightly lighter colored than head, bilobed, projecting. Labrum yellow-brown, tongue-shaped.

Antenna yellow-brown, 17 segments, with long hairs; third segment very small, ringlike, not a third as long as second which is subclavate; fourth slightly longer; from fifth on, segments become longer and broader; last segment elongate, slender, subelliptical.

Pronotum same color as head, slightly raised anteriorly where margin is nearly straight, sides roundedly slope to posterior margin which is emarginate; with dense short and scattered longer hairs.

Wings hyaline, slightly smoky, costal veins yellow-brown, margins ciliate, surface with sculpturing similar to that described for *C.* (*N.*) *opacus* Hagen by Silvestri. Fore wing with median nearer to cubitus and branched to apex of wing; cubitus and sub-branches take up most of wing area, does not reach apex, with 9–10 branches to margin of wing. Hind wing with median near cubitus and branched to apex of wing, cubitus takes up less wing area, with 9–12 branches and sub-branches to margin of wing.

Legs yellow-brown, tibiae dark brown, slender, with long hairs.

Abdomen with tergites same color as head, with dense short hairs and longer hairs near base each tergite, cerci prominent.

Measurements.—

Length of entire winged adult, 15.50 mm.
Length of entire deälated adult, 9.50–10.00 mm.
Length of head, 1.90 mm.
Length of pronotum, 0.80 mm.
Length of fore wing, 13.00 mm.
Length of hind tibia, 1.80 mm.
Diameter of eye (long diameter), 0.45 mm.
Width of head (at eyes), 1.65–1.75 mm.
Width of pronotum, 1.40–1.45 mm.
Width of anterior wing, 3.50 mm.

C. (*N.*) *parallelus* Snyder is a smaller species than *C.* (*N.*) *opacus* Hagen, has a hyaline fontanelle and larger ocelli which are nearer to the eyes.

Soldier.—Head yellow (lighter colored than *opacus*), sides parallel (slightly convex in middle), head slightly narrower anteriorly (narrower head than *opacus*), rounded posteriorly, truncate anteriorly, an orange, median, longitudinal impression extending from posterior margin to frontal gland and base of epicranial suture; with scattered, long hairs. Gula with sides parallel, broader in middle than in *opacus.*

Labrum yellow, elongate, narrow, trilobed at apex, narrowed at base, follows outline of left mandible, long hairs at apex.

Mandibles black, left longer than right, broad even at apex, right slightly pointed at apex beyond curve where it fits into the left mandible, left doubly curved, right nearly straight; mandibles shorter but of same general shape as in *opacus.*

Antenna light yellow-brown, 16 segments, with long hairs; third segment only slightly longer than second (in *opacus* nearly twice as long); fourth segment shorter than third; segments become longer and broader to apex; last segment elongate, narrow, subelliptical.

Pronotum white tinged with yellow, saddle-shaped, anterior margin broadly rounded, markedly emarginate, sides roundedly slope to posterior margin which is nearly straight; with dense long hairs.

Legs white, tinged with yellow, elongate slender, pubescent.

Abdomen dirty gray-white, tinged with yellow, with dense long hairs; cerci prominent.

Measurements.—

Length of entire soldier, 9.00–10.00 mm.
Length of head with mandibles, 5.50 mm.
Length of head to anterior, 3.00–3.10 mm.
Length of left mandible, 2.50 mm.
Length of pronotum, 0.60 mm.
Length of hind tibia, 1.45 mm.
Width of head posteriorly, 1.80–1.90 mm.
Width of head anteriorly, 1.70 mm.
Width of pronotum, 1.10 mm.

C. (*N.*) *parallelus* Snyder is a lighter colored, smaller species than *opacus;* there are also differences in antennal segmentation. Compared with specimens of *opacus* determined by F. Silvestri. Silvestri's *opacus*, variety *parvus*, is not described with sufficient detail for purposes of comparison, the soldier is smaller than *parallelus; parvus* may be merely a biological variety of *opacus.*

Type locality.—Rosario (Lake Rogogua), Bolivia.

Described from a series of winged female and male adults, soldiers and workers, collected at the type locality by W. M. Mann.

Type, female, winged adult.—Cat. No. 27676, U.S.N.M.; morphotype, soldier.

This termite was also collected as follows:

CAPRITERMES (NEOCAPRITERMES) PARALLELUS Snyder

Rosario (Lake Rogogua), Bolivia, October, 1921 (soldiers and workers); Rosario, Bolivia, November, 1921 (soldiers and workers); Rosario, Bolivia, November, 1921 (winged adults, soldiers, and workers); Rosario, Bolivia, November, 1921 (soldiers and workers with winged adults of *Anoplotermes* (*A.*) *pacificus* Fritz Müller and *rotundus* Snyder in termite hills); Cavinas, Bolivia, February, 1922 (soldiers and workers); Ivon, Bolivia, February, 1922 (soldiers and workers).

CAPRITERMES (NEOCAPRITERMES) VILLOSUS Holmgren

Soldier.[14]—Epicranium of head yellow-brown, light castaneous-brown anteriorly and at sides, longitudinal, depressed median line reddish-brown, head broadest posteriorly, narrows towards anterior, frontal gland at end of median line in V-shaped depression (epicranial suture), head with dense, reddish, short hairs, few scattered longer hairs.

Labrum castaneous-brown, broadest at apex, trilobed.

Antenna light castaneous-brown, 16 segments, pubescent; third segment subclavate, longer than second and fourth segments; segments from fifth to eleventh elongate and wide; segments from twelfth to sixteenth shorter and narrower; last segment slender and pointed at apex.

Pronotum light yellowish, margins light castaneous-brown, saddle-shaped, with long hairs on margins, markedly emarginate anteriorly and emarginate posteriorly.

Legs light yellow-brown, elongate, slender, pubescent, claws castaneous-brown.

Abdomen light yellow brown, with dense, long, yellowish hairs.

Measurements.—

Length of entire soldier, 16.50–16.75 mm.
Length of head with mandibles, 10.50–10.75 mm.
Length of head without mandibles (to anterior), 5.90 mm.
Length of left mandible, 5.20 mm.
Length of pronotum, 1.00–1.10 mm.
Length of hind tibia, 3.40–3.50 mm.
Width of head, 4.80–4.90 mm.
Width of pronotum (at widest portion), 2.85–2.90 mm.

[14] Description agrees with soldier as figured by N. Holmgren, fig. Qc, p. 558, Zoolog. Jahrbüch, vol. 23, 1905–6, Jena, but these soldiers are larger.

These soldiers are larger than the specimens of *villosus*, collected by Holmgren in Peru, and may be a new species. Doctor Mann collected the two soldiers from which the above description was made with workers at Uniao, Lower Rio Madeira, Brazil, in March, 1922. These specimens are deposited in the collection of the United States National Museum.

Another known species of *Neocapritermes* which was also collected is the very striking, flat-headed *Capritermes* (*Neocapritermes*) *planiceps* Emerson, found at Cavinas, Bolivia, soldiers and workers, February, 1922; Cachuela Esperanza (Beni River), Bolivia, soldiers and workers, March, 1922. This termite was first found in British Guiana.

Genus ORTHOGNATHOTERMES Holmgren

Species of the genus *Orthognathotermes* are restricted to America. Only four species have been described, three from South and one from Central America. The elongate mandibles of the soldier are not asymmetrical as in *Capritermes* Wasmann and *Neocapritermes* Holmgren; but are also bowed in the middle (with knees).

ORTHOGNATHOTERMES BREVIPILOSUS, new species

Soldier.—Head yellow-brown, darker (light castaneous-brown) anteriorly, but lighter posteriorly, widest at middle, sides convex, wider posteriorly than anteriorly, tapers to anterior margin, above upper borders of antennal sockets flattened tubercles. Head with eye spots? back of tubercles not very prominent; with scattered long hairs and numerous (dense) short hairs.

Labrum yellow-brown, broader than long, weakly 3 lobed, central lobe largest, almost conical, with long hairs.

Mandibles black, bases reddish-brown, elongate, bowed in middle, with marginal tooth at the bend; strongly incurved at the tips.

Antenna yellow-brown, 15 segements, pubescent; second segment shorter than fourth; third segment shorter than second or fourth; from fourth segment on segments become longer and broader; toward apex, however, segments become shorter and narrower.

Pronotum yellowish, saddle-shaped, anteriorly emarginate, with dense long hairs.

Legs yellowish, claws brown, legs elongate, pubescent.

Abdomen dirty gray-white with tinge of yellow, with dense long hairs.

Measurements.—

Length of entire soldier, 8.50–8.75 mm.
Length of head with mandibles, 5.0–5.75 mm.
Length of head without mandibles (to tip of labrum), 3.3–3.5 mm.
Length of head without mandibles (to anterior), 3.05 mm.

Measurements—Continued.

Length of left mandible, 2.65–2.80 mm.
Length of pronotum, 0.35–0.40 mm.
Length of hind tibia, 1.55 mm.
Width of head (at widest portion), 2.2–2.3 mm.
Width of pronotum, 1.40 mm.

O. brevipilosus Snyder is near *O. macrocephalus* Holmgren but is larger, has dense short hairs on the head, and the sides of the head are *convex; brevipilosus* has a shorter, narrower head than *orthognathus* Silvestri, with narrower mandibles and tubercles, as well as dense short hairs (lacking in *orthognathus*); *brevipilosus* is larger and has a broader, more hairy head than *wheeleri* Snyder; *brevipilosus* is larger than *globicephalus* Silvestri.

Type locality.—Rosario, Bolivia.

Described from a series of soldiers collected at the type locality, with workers in November, 1921, by W. M. Mann.

Type, soldier.—Cat. No. 27674, U.S.N.M.

Another species of this genus collected is *Orthognathotermes macrocephalus* Holmgren, found at Rosario, Bolivia; soldier in termite hills.

Genus MICROCEROTERMES Silvestri

The genus *Eutermes* was founded in 1849 by Heer for several fossil winged termites; one of these species, *E. debilis*, according to Hagen, was from gum copal. Hagen examined the type and identified it with a living species from Porto Rico. N. Banks (1920) examined one of Hagen's specimens from Porto Rico and states that it is a *Microcerotermes* allied to *M. strunckii* Sörensen. Banks selected *E. debilis* Heer as type of *Eutermes* Heer. *Eutermes* Heer would then replace *Microcerotermes.*

However, I agree with C. Fuller (1924) that there is considerable doubt as to the ability of Hagen to determine that dried specimens are the same specifically as the fossil specimen. Species of *Microcerotermes* are difficult enough to determine where fresh material is available. Hence, I am referring species to the genus *Microcerotermes* Silvestri, which formerly I placed in the genus *Eutermes* Heer. Instead of using the name *debilis* Heer for living species, I am referring certain American specimens to *arboreus* Emerson and until the identity of *debilis* Heer can be established, ignoring this species and discarding *Eutermes.*

The winged adults of species of *Microcerotermes* have the head more or less elongate, with oval parallel sides; the eyes are relatively small and set parallel to the sides of the head; the ocelli are small and are more or less distant from the eyes. The fontanelle is often indistinct. The antennæ have 14–15 segments and the third segment is shorter than the second.

The pronotum is relatively small, much narrower than the head. The wing membrane is plainly hairy and the cubital vein runs out somewhat before the tip.

The soldiers have the mandibles set well in from the lateral margins of the head and the inner margins of the mandibles are denticulate.

The genus is well distributed throughout the world and contains numerous species.

Only one species, namely [*E.*] *M. arboreus* Emerson, was found on the Mulford Expedition; *bouvieri* Desneux, *exiguus* Hagen, and *strunckii* Sörensen are other American species. The localities where this termite was collected are:

[EUTERMES] MICROCEROTERMES ARBOREUS Emerson

Cachuela Esperanza (Beni River), Bolivia, March, 1922 (queen, soldiers and workers); Rosario, Bolivia, November, 1921 (soldiers and workers with *Nasutitermes* (*N.*) *aurantiacus* Holmgren (queen, soldiers and workers in tree nest); Rurrenabaque, Bolivia, October, 1921 (queen, soldiers and workers—3 series); Rurrenabaque, Bolivia (No. 5, winged adults, queen, soldiers and workers); San Gregorio, Beni, Bolivia, October, 1921 (queen, soldiers and workers); St. Helena, Bolivia (soldiers and workers).

LIST OF KNOWN AND NEW SPECIES OF TERMITES COLLECTED BY THE MULFORD EXPEDITION TO BRAZIL AND BOLIVIA, 1921–1922

BRAZIL

KALOTERMITIDAE (0)

RHINOTERMITIDAE (1)

Described species	Number
Rhinotermes taurus Desneux (=*nasutus* Perty)	

TERMITIDAE (4)

Described species	Number	New species	Number
Cornitermes (C.) similis Hagen			
Nasutitermes (N.) macrocephalus Silvestri			
Capritermes (Neocapritermes) villosus Holmgren		*Capritermes (Neocapritermes) braziliensis*, new species	
Total	3	Total	1
Total	4	Grand total	5

BOLIVIA

KALOTERMITIDAE (2)

New species	Number
Kalotermes (Neotermes) magnoculus, new species	
Kalotermes (Neotermes) manni, new species	
	2

BOLIVIA—Continued

RHINOTERMITIDAE (6)

Described species	Number	
Leucotermes tenuis Hagen		
Coptotermes marabitanus Hagen		
Rhinotermes marginalis Linnaeus		*Rhinotermes latilabrum*, new species
Rhinotermes taurus Desneux		*Rhinotermes manni*, new species
	4	2

TERMITIDAE (67)

Syntermes braziliensis Holmgren	
Syntermes chaquamayensis Holmgren	
Cornitermes (C.) cumulans Kollar	*Cornitermes (C.) bolivianus*, new species
Cornitermes (C.) lespesi Fritz Müller	
Cornitermes (C.) similis Hagen	
Cornitermes (C.) striatus Hagen	
Cornitermes (Labiotermes) labralis Holmgren	
Armitermes (A.) albidus Hagen.	*Armitermes (A.) benjamini*, new species.
Armitermes (A.) cuamignathus Silvestri.	*Armitermes (A.) holmgreni*, new species.
Armitermes (A.) festivellus Silvestri.	*Armitermes (A.) manni*, new species.
Armitermes (A.) tecvani Emerson.	
Armitermes (Curvitermes) odontognathus Silvestri.	
Armitermes (Rhynchotermes) nasutissimus Silvestri.	
Nasutitermes (Nasutitermes) aurantiacus Holmgren.	*Nasutitermes (Nasutitermes) aduncus*, new species.
Nasutitermes (Nasutitermes) brasiliensis Holmgren.	*Nasutitermes (Nasutitermes) crassus*, new species.
Nasutitermes (Nasutitermes) chaquimayensis Holmgren.	*Nasutitermes (Nasutitermes) pilosus*, new species.
Nasutitermes (Nasutitermes) cornigera Motschulsky.	
Nasutitermes (Nasutitermes) ephratae Holmgren.	
Nasutitermes (Nasutitermes) macrocephalus Silvestri.	
Nasutitermes (Nasutitermes) major Holmgren.	
Nasutitermes (Nasutitermes) maximus Holmgren.	
Nasutitermes (Nasutitermes) minimus Holmgren.	
Nasutitermes (Nasutitermes) minor Holmgren.	
Nasutitermes (Nasutitermes) rotundatus Holmgren.	
Nasutitermes (Nasutitermes) surinamensis Holmgren.	
	Nasutitermes (Subulitermes) angusticeps, new species.
	Nasutitermes (Convexitermes) pallidus, new species.

BOLIVIA—Continued

TERMITIDAE (67)—continued

	Nasutitermes (*Convexitermes*) *pulliceps*, new species.
Nasutitermes (*Diversitermes*) *castaniceps* Holmgren.	*Nasutitermes* (*Diversitermes*) *melanocephalus*, new species.
Nasutitermes (*Diversitermes*) *diversimiles* Silvestri.	*Nasutitermes* (*Velocitermes*) *uniformis*, new species.
	Nasutitermes (*Agnathotermes*) *glaber*, new species.
	Nasutitermes (*Tenuirostritermes*) *laticephalus*, new species.
Nasutitermes (*Constrictotermes*) *cavifrons* Holmgren.	*Anoplotermes* (*Anoplotermes*) *bolivianus*, new species.
Anoplotermes (*Anoplotermes*) *nigropunctatus* Emerson.	*Anoplotermes* (*Anoplotermes*) *clypeatus*, new species.
Anoplotermes (*Anoplotermes*) *pacificus* Fritz Müller.	*Anoplotermes* (*Anoplotermes*) *distans*, new species.
	Anoplotermes (*Anoplotermes*) *distinctus*, new species.
	Anoplotermes (*Anoplotermes*) *grandifons*, new species.
	Anoplotermes (*Anoplotermes*) *howardi*, new species.
	Anoplotermes (*Anoplotermes*) *indistinctus*, new species.
	Anoplotermes (*Anoplotermes*) *linearis*, new species.
	Anoplotermes (*Anoplotermes*) *proximus*, new species.
	Anoplotermes (*Anoplotermes*) *punctatus*, new species.
	Anoplotermes (*Anaplotermes*) *rotundus*, new species.
Anoplotermes (*Speculitermes*), species.	
	Cylindrotermes brevipilosus, new species.
	Mirotermes (*M.*) *bolivianus*, new species.
Mirotermes (*Spinitermes*) *brevicornutus* Holmgren.	*Mirotermes* (*Spinitermes*) *robustus*, new species.
Mirotermes (*Spinitermes*) *trispinosus* Hagen.	
Capritermes (*Neocapritermes*) *paniceps* Emerson.	*Capritermes* (*Neocapritermes*) *hopkinsi*, new species.
	Capritermes (*Neocapritermes*) *parallelus*, new species.
Orthognathotermes macrocephalus Holmgren.	*Orthognathotermes brevipilosus*, new species.
Microcerotermes arboreus Emerson.	

BOLIVIA—Continued

TERMITIDAE (67)—continued

	Described species	New species	Total
	Number	Number	
Total			
Kalotermitidae	0	2	2
Rhinotermitidae	4	2	6
Termitidae	36	31	67
Grand total Bolivia	40	35	75
Grand total Bolivia and Brazil	41	36	77

EXPLANATION OF PLATES [15]

PLATE 1

Contrasting views of soldiers of striking American *Rhinotermes* and of soldiers of a new *Cornitermes* and *Cylindrotermes*.

FIG. 1. Dorsal view of head and pronotum of major soldiers of *Rhinotermes longidens* Snyder to show elongate labrum and marginal teeth of mandibles.

2. Dorsal view of head and pronotum of minor soldier of *Rhinotermes manni* Snyder to show shape of head, labrum, and mandibles.

3. Dorsal view of head of winged adult of *Anoplotermes* (*Anoplotermes*) *grandifons* Snyder to show large fontanelle (slightly on a bias). (Camera lucida.)

4. Dorsal view of mandibles of soldier of *Cornitermes* (*Cornitermes*) *bolivianus* Snyder to show lack of prominent marginal teeth. (Camera lucida.)

5. Dorsal view of head and pronotum of major soldier of *Rhinotermes manni* Snyder to show normal short labrum and marginal teeth of mandibles.

6. Dorsal view of head and pronotum of major soldier of *Rhinotermes latilabrum* Snyder to show elongate, broader labrum and marginal teeth of mandibles. (Note that large marginal tooth of right mandible is broken.)

7. Dorsal view of head and pronotum of the soldier of *Cylindrotermes brevipilosus* Snyder showing short pubescence and mandibles.

8. Dorsal view of head and pronotum of major soldier of *Rhinotermes longilabius* Emerson to show elongate labrum and marginal teeth of mandibles.

9. Dorsal view of head and pronotum of minor soldier of *Rhinotermes latilabrum* Snyder to show elongate, broad labrum and elongate mandibles.

10. Dorsal view of head and pronotum of minor soldier of *Rhinotermes longidens* Snyder to show extended slender labrum and absence of mandibles.

[15] All the free-hand drawings were made by Miss E. T. Armstrong, while the camera lucida sketches were made by the author.

PLATE 2.

A new *Nasutitermes*, contrasting views of soldiers of *Syntermes* and the soldier of a *Spinitermes*.

FIG. 1. Dorsal view of soldier of *Nasutitermes* (*Nasutitermes*) *aduncus* Snyder to show shape of head and nasus; note head is slightly asymmetrical. (Camera lucida.)

2. Lateral view of soldier of *Nasutitermes* (*Nasutitermes*) *aduncus* Snyder to show shape of head and large, robust, aquiline nasus. (Camera lucida, same scale as dorsal view.)

3. *Mirotermes* (*Spinitermes*) *trispinosus* Hagen. Soldier. Dorsal view of head and pronotum to show mandibles and three anterior processes. (Specimen collected at Cachuela Esperanza, Beni River, Bolivia, in March, 1922.)

4. Dorsal view of head and pronotum of *Syntermes chaquamayensis* Holmgren to show marginal teeth of mandibles and spines on thorax.

5. Dorsal view of head and pronotum of *Syntermes molestus* Burmeister to show mandibles without prominent marginal teeth and lacking prominent spines on thorax. (View of left mandible inset.)

6. *Mirotermes* (*Spinitermes*) *trispinosus* Hagen. Soldier. Lateral view of head and pronotum to show mandibles and three anterior processes. (Specimen collected at Cachuela Esperanza, Beni River, Bolivia, in March, 1922.)

7. Dorsal view of head and pronotum of *Syntermes snyderi* Emerson to show marginal teeth of mandibles and spines on thorax.

8. Dorsal view of head and pronotum of *Syntermes peruanus* Holmgren to show marginal teeth of mandibles and spines on thorax.

9. Dorsal view of head and pronotum of *Syntermes braziliensis* Holmgren to show mandibles without prominent marginal teeth and lacking prominent spines on thorax.

PLATE 3.

Soldiers of three subgenera of *Nasutitermes* Banks

Nasutitermes (*Diversitermes*) *melanocephalus* Snyder

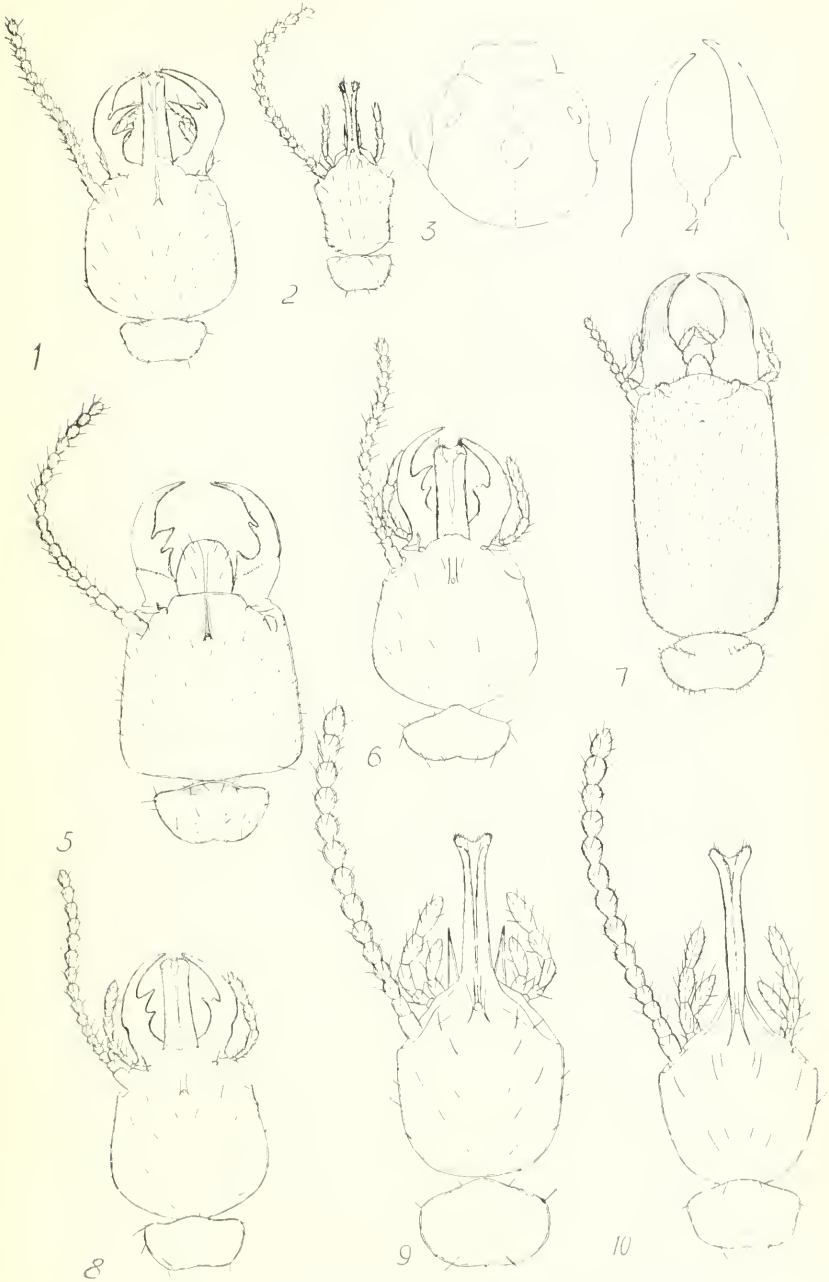
FIG. 1. Soldier (major) dorsal view of head and pronotum.
2. Soldier (major) lateral view of head and pronotum.
3. Soldier(intermediate) dorsal view of head and pronotum.
4. Soldier (intermediate) lateral view of head and pronotum.
5. Soldier (minor) dorsal view of head and pronotum.
6. Soldier (minor) lateral view of head and pronotum.

Nasutitermes (*Tenuirostritermes*) *laticeps* Snyder

FIG. 7. Soldier dorsal view of head and pronotum.
8. Soldier lateral view of head and pronotum.

Nasutitermes (*Velocitermes*) *uniformis* Snyder.

FIG. 9. Soldier (major) dorsal view of head and pronotum.
10. Soldier (major) lateral view of head and pronotum.
11. Soldier (minor) dorsal view of head and pronotum.
12. Soldier (minor) lateral view of head and pronotum.



SOLDIERS OF RHINOTERMES, CORNITERMES, AND CYLINDROTERMES

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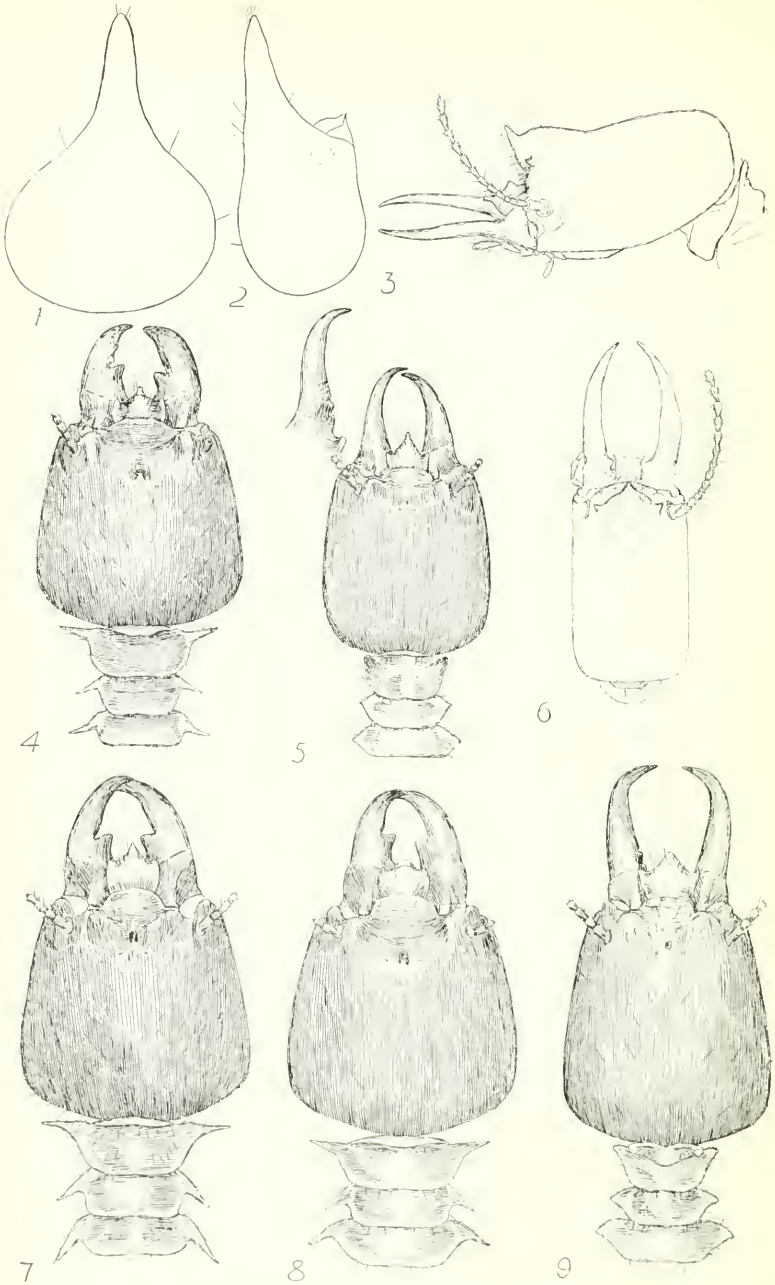

SOLDIERS OF NASUTITERMES, SYNTERMES, AND SPINITERMES

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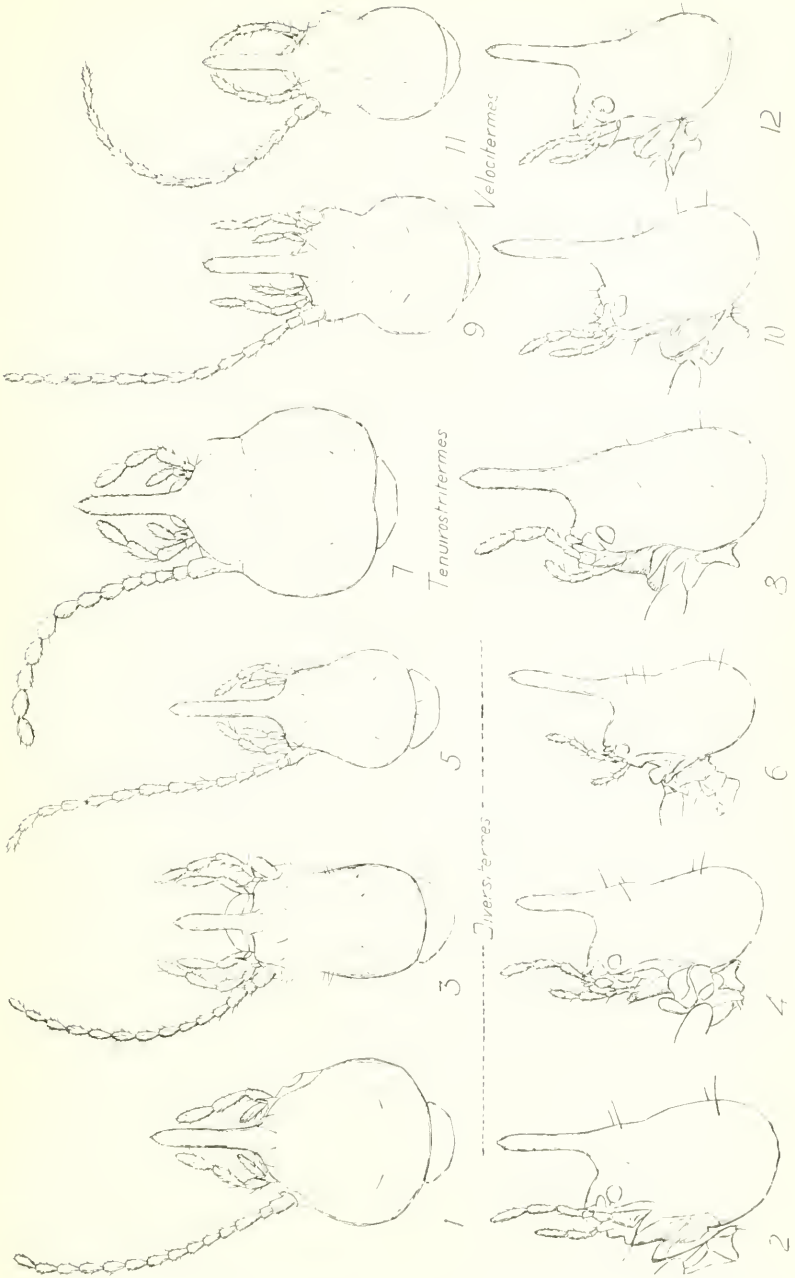


SOLDIERS OF NEW DIVERSITERMES, TENUIROSTRITERMES, AND VELOCITERMES

FOR EXPLANATION OF PLATE SEE PAGE 76

A NEW NEMATODE FROM THE RAT, AND ITS LIFE HISTORY

By Eloise B. Cram

Of the Zoological Division, Bureau of Animal Industry, United States Department of Agriculture

Through the courtesy of the superintendent of the National Zoological Park, Washington, D. C., there were turned over to the present writer about 20 wild rats (*Rattus norvegicus*) which had been killed in the Park. Upon postmortem examination the large majority of the rats were found to harbor spirurid worms. The nematodes were unusually large, and present in such numbers that in many cases the stomach, esophagus, and upper end of intestine were distended and densely packed with the worms. Upon examination the nematode proved to be a new species of *Protospirura.* Several rats caught in another part of Washington (Department of Agriculture buildings, about 5 miles from the Zoological Park) failed to show the presence of these nematodes and the high percentage of incidence in wild rats from the grounds of the Park therefore suggested that the rat was not the normal or original host but had derived the infestation from some other rodent present in the Zoological Park. The possibility that zoological gardens might act as disseminators of parasites and that the rat might play an important role in that dissemination is worthy of consideration, and it was thought by the present writer that a study of this nematode and its life history might have practical as well as scientific interest. The description of the parasite and the experiments on its life history are given below.

PROTOSPIRURA COLUMBIANA, new species

Specific diagnosis.—Protospirura: Large worms, the variations of size of the adult worms, however, being unusually extensive. Cuticle with transverse striations and, in addition, thrown into loose folds, the cuticle being so loose and distended in many of the worms as to give the appearance of a larval cuticle about to be shed. Head with 2 large trilobed lips. The lobes are of approximately equal size, but the lateral lobes taper somewhat anteriorly, whereas the 2

No. 2616.—Proceedings U. S. National Museum, Vol. 68, Art. 15.
60731—25

median lobes are broadly rounded. Each lobe has on its inner surface an anteriorly projecting plate, the free edge of which is dentate, that of the median lobe having a large central tooth and at each side 4 or 5 smaller teeth; that of the lateral lobes 3 teeth at each side of the large central one. The lobes of each lip appear quite discreet, there being considerable space between them; they have a heavy chitinous lining. Four submedian papillae present. Mouth opening oval, elongate dorso-ventrally; pharynx large, cylindrical, its diameter increasing somewhat posteriorly. Nerve ring surrounding esophagus near its anterior end; cervical papillae very small, located in depressions of the cuticle at the level of the nerve ring; excretory pore a short distance posterior to the nerve ring.

Male.—Total length 22 to 43 mm.; width 600μ to 1.2 mm. In a specimen of medium size the width of the head at base of lips is 160 to 165μ; the lips are 50μ long, the median lobe 58μ wide; width of body at posterior end of esophagus 500μ, at the curve of the caudal end 500μ, at the level of the cloacal aperture 350μ. Pharynx 150 to 160μ long by 60 to 75μ wide; esophagus 4.2 mm. long ($\frac{1}{7}$ of total body length) by 300μ in maximum width; nerve ring 200μ from anterior end of esophagus. Posterior end of body tightly coiled. Tail short, the cloacal aperture $\frac{1}{50}$ of total body length from posterior end. Two caudal alae of approximately equal size, measuring 1.4 mm. long in large specimens; the maximum width of 265μ attained at about the middle of their length; they have fine wavy transverse striations and their outer edge is irregular. Ventral surface of body for a distance of 5.5 to 6 mm. anterior to caudal end provided with vesicular swelling of cuticle. As seen from the ventral surface, with the cover glass compressing the vesicular inflation of the cuticle laterally, the caudal alae are completely hidden from view, lying dorsal to this inflation. The latter is covered with rounded oblong markings of varying size, similar to those found in other species of the genus. In addition to the oblong markings, and correlated with them, are brilliantly refringent dots, confined to the ventral region and the posterior half of the vesicular inflation, gradually disappearing laterally and anteriorly. These dots are not superficial, as are the markings, but lie just below the surface. Not only the circumcloacal region but also the median ventral surface of the body from the cloacal aperture to the tail end is devoid of both the oblong markings and the dots. Six pairs of long pedunculated papillae, of which four pairs are preanal and two pairs postanal; in addition there are five pairs of very small sessile papillae at the caudal extremity, which are not apparent except in a direct ventral view of the tail. Spicules slightly unequal, the one 1.3 to 1.4 mm. long by 33 to 37μ wide, with distal end rounded; the other 1.03 to 1.07 mm. long by 18μ wide, with distal end sharply

pointed. The sheath of the longer spicule is strongly developed; when the spicule is extruded the sheath is compressed accordion-like, its numerous ridges or folds being seen clearly through the body wall when the specimen is cleared, whereas when the spicule is completely drawn into the body the sheath is extended so that its walls are smooth. There is a distinct telamon present, sharply limiting the cloacal aperture; it appears to be horseshoe shaped, the open ends directed anteriorly.

Female.—Total length 45 to 100 mm.; width 800μ to 2.4 mm. In a specimen of medium size the width of head at base of lips is 265μ, the pharynx 215μ long, its lumen 66μ in diameter, its walls 17μ thick. Esophagus 6.4 mm. long ($\frac{1}{15}$ of total body length), the nerve ring 250μ from its anterior end. Uterus extends anteriorly to a point 1.7 mm. posterior to the junction of esophagus and intestine. Caudal extremity bluntly rounded, the cuticle thrown in loose folds. The anus is not situated at the level of the superficial cuticle but at the bottom of a channel formed by a prepucelike sheath. The anus is 750μ to 1.2 mm. from tail end whereas the opening of the sheath is 400 to 580μ from the extremity. Vulva inconspicuous, situated slightly anterior to middle of body, dividing the body length in ratio of 4:5. The posteriorly-directed vagina, 531μ long, is followed by a slightly enlarged sphincter, 183μ long, and that by the unpaired portion of the uterus which after a length of 1.6 mm. divides into the two divergent uterine branches. Eggs 52 to 58μ by 30 to 33μ; the embryo, measured after being released from the shell, 232μ long by 10μ wide, with a small knob bearing minute spines at its tail end.

A male and female were observed in copula (fig. 9), the posterior end of the male being tightly coiled around the body of the female, in the region of the vulva. The tight clasp constricts the female body very decidedly anterior to the vulva and suggests that its purpose may be not only to secure the female but possibly to dilate the vulva and vagina.

Fourth-stage larva (fig. 13) 6.6 mm. long by 257μ wide to 11.5 mm. long by 300μ wide; first part of esophagus 150μ, second part of esophagus 3.3 mm. long; anus 216μ from tail end.

Host.—*Rattus norvegicus.*

Location.—Stomach and, occasionally, esophagus and anterior end of small intestine.

Locality.—Washington, D. C.

Type material.—No. 26383, paratypes No. 26384, U.S.N.M. (Bureau of Animal Industry) Helminthological Collections.

Life history.—On October 2, 1924, a culture was made in physiologic saline solution of embryonated eggs from the uteri of several worms and fed on bread to several cockroaches (croton bugs or

Ectobia germanica). On October 6 the culture was found to be covered with a heavy mold but the eggs were apparently unharmed as no change was apparent in them. The culture was divided into 3 parts and to these were added the following, respectively: charcoal, a little potassium bichromate and about 2 per cent formalin. The roaches were fed from these cultures at irregular intervals during the month of October.

On October 26 one roach was found dead. Upon dissection numerous larvae of various sizes were found free in the body cavity; none could be found to have encysted. The larvae (apparently second stage) measured 90μ to 1.1 mm. long; the tail end was devoid of spinous processes.

On November 3 the dissection of a second roach, found dead on that day, revealed a large number of spirurid larvae, in the loose tissue of the body cavity, especially in that around the tracheal tubes. Many of the larvae were coiled in a tight spiral and exhibited very sluggish movement; several were in loose cysts. The larvae (apparently third stage) measured 1.1 to 1.2 mm. long by 50μ wide; first part of esophagus 66μ long, second part of esophagus 440μ long, anus 75μ from tail end. In lateral view the end of the tail showed 4 spinous processes, the 2 median being larger than the 2 outer. About 10 larvae were fed to a white mouse and about 20 to a white rat. The mouse died on November 17 but no spirurids were found in the stomach or esophagus; the rat was killed on December 27 and the findings in regard to it were also negative.

On November 13 a roach which was killed and dissected, was found to have 19 encysted larvae in the abdominal cavity. Six of the larvae were fed to a white mouse which died on November 15 with evidences of hemorrhage, there being blood at the mouth and blood clots in the stomach. One spirurid larva was found in the stomach; it was of about the same size (1.2 mm. by 50μ) as the encysted ones which had been fed.

On December 1 a roach which was killed and dissected was found to contain numerous encysted larvae in the abdominal and thoracic cavities, the cysts being loose among the tissues around the mouth parts, in the fleshy coxa of the legs, and among the salivary glands and the Malpighian tubes. Forty-three cysts were collected, a few of them containing 2 larvae but the great majority only one. The cysts measured about 425 to 440μ in diameter; the larvae were the same size (1.2 mm. by 50μ) as those collected from roaches previously examined. A white mouse was fed 8 cysts, and 2 white rats 12 cysts apiece. The mouse died on December 15 but no spirurids could be found in the esophagus or stomach. One of the rats was killed on January 5 and 4 immature specimens of *P. columbiana* found in the stomach, 3 males (17 to 20 mm. long by 450 to 500μ wide) and 1

female (28 mm. long by 500μ wide). The second white rat died on January 23; upon postmortem examination 2 specimens of *P. columbiana*, mature but not fully grown adults, were found in the stomach, one male (24 mm. long by 500μ wide) and one female (30 mm. long by 850μ wide).

On December 27 encysted larvae, obtained by dissection of one of the remaining roaches, were fed to white rates and mice. On April 21, 2 of the rats and 1 mouse were killed. From the stomach of one rat were recovered 8 specimens of *P. columbiana* (7 females and 1 male), from that of the second rat 7 specimens (3 females and 4 males), and from that of the mouse 1 specimen (male). These nematodes had attained the size of those found originally in the wild rats, the females measuring up to 88 mm. long by 2.2 mm. wide, the males up to 43 mm. long by 1 mm. wide.

A tabulated summary of the above feeding experiments is as follows:

Roaches		Rats and mice	
Time between feeding and death	Findings	Time between feeding and death	Findings
Days		*Days*	
23	Numerous larvae (1.0 to 1.2 mm. long) free in body cavity.	13	negative.
		54	negative.
		2	1 spiruid larva in stomach.
31	Many larvae (1.1 to 1.2 mm. long by 50μ wide; mostly free, a few in cysts).	14	negative.
		35	4 spirurids in stomach, (*P. columbiana*, 3 ♂ ♂ (17 to 20 mm. long), 1 ♀ (28 mm. long)).
41	19 encysted larvae (1.1 mm. long).		
		53	2 spirurids in stomach 1 ♂ (24 mm. long), 1 ♀ (30 mm. long)).
58	Numerous encysted larvae (1.1 to 1.2 mm. long).		
85	Numerous encysted larvae.	115	1 spirurid in stomach (♂, 38 mm.)
197	Numerous encysted larvae.	115	8 spirurids in stomach (1 ♂ (43 mm. long), 7 ♀ ♀ (up to 85 mm. long)).
		115	7 spirurids in stomach (4 ♂ ♂ (up to 43 mm.), 3 ♀ ♀ (up to 88 mm. long)).

KNOWN SPECIES OF PROTOSPIRURA

The species of the genus *Protospirura* may be distinguished as follows:

1. Each lobe of lips with 1 large tooth and 2 smaller teeth; 6 cephalic papillae; eggs 16μ long by 7μ wide ..... *P. labiodentata.*
   Lobes of lips with teeth of different number than above; 4 cephalic papillae; eggs, where known, much larger than 16μ by 7μ ..... 2.

2. Only male known, 23 mm. long by 564μ wide; spicules 622μ and 1.1 mm. long ..... *P. gracilis.*
   Both male and female known, the male not as slender as 564μ; spicule lengths different from those of *P. gracilis* ..... 3.
3. Median lobe of lips toothless; vulva at level of posterior third of body, dividing body length in ratio of 2:1; spicules equal, 395μ long ..... *P. bonnei*
   Median lobe of lips with teeth; vulva anterior to middle of body; spicules unequal, the long spicule always more than 395μ ..... 4.
4. Long spicule not over 830μ; short spicule not over 420μ ..... 5.
   Long spicule over 1 mm.; short spicule 622μ or longer ..... 6.
5. Long spicule 830μ; short spicule 420μ ..... *P. numidica.*
   Long spicule 480μ; short spicule 350μ ..... *P. muricola.*
6. Vulva a little anterior of union of anterior and middle third of body; difference in length of the 2 spicules more than 500μ ..... *P. ascaroidea.*
   Vulva slightly anterior of middle of body; difference in length of the 2 spicules not over 300μ ..... 7.
7. Male not over 28 mm. long; female not over 40 mm. long; median lobe of lips with a large central tooth and 2 smaller teeth on each side; tail of male 1/41 of total body length ..... *P. muris.*
   Male up to 43 mm. long; female up to 100 mm. long; median lobe of lips with a long central tooth and 4 or 5 smaller teeth on each side; tail of male 1/50 of total body length ..... *P. columbiana.*

SUMMARY.

A new species of nematode, *Protospirura columbiana*, was found in the stomach and esophagus of wild rats (*Rattus norvegicus*) killed at the National Zoological Park, Washington, D. C. Life history experiments resulted in the successful development of the encysted larval stage of the nematode in cockroaches (croton bugs, *Ectobia germanica*). The larvae begin to encyst about one month after the eggs are fed to the roaches, but they are apparently not infective at that time. After 41 days they appear to have reached the infective stage, one of the larvae being present in the stomach of a mouse at its death 2 days after the feeding of the encysted form. Adult nematodes were developed in rats by feeding the encysted larvae obtained from a roach 58 days after the latter was fed the embryonated eggs. The nematodes are still immature 35 days after the feeding of the final host; after 53 days they are mature but not fully grown, whereas after 115 days they have attained the size of the majority of the nematodes found in natural infections.

The only other life history of a species of *Protospirura* that appears to be known is that of *P. muris*. Leuckart (1867) and Marchi (1871) found that encapsuled larvae develop in meal worms, *Tenebrio* species, about 5 weeks after the nematode eggs had been eaten by the worm.

The finding of *P. columbiana* in wild rats in the Zoological Park but not in those from other parts of the city suggests the possibility

that the normal host may be a rodent other than the rat, present in the Park. That rats and cockroaches, pests commonly present around such places, may play a part in the dissemination of parasites formerly absent in a country but brought in by the animals in the Zoological Park, is a possibility the recognition of which might have a practical significance.

EXPLANATION OF PLATES

PLATE 1.

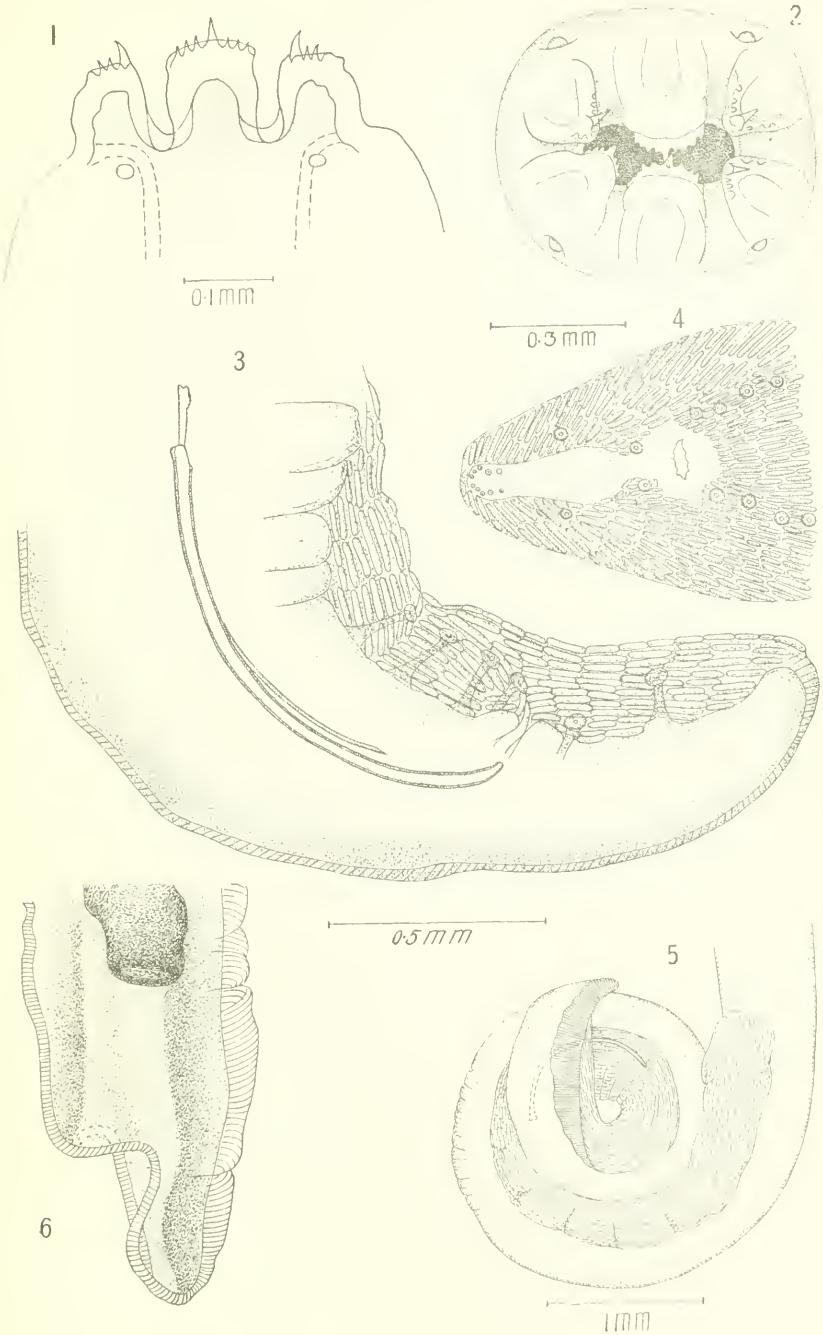
Protospirura columbiana, new species

FIG. 1. Head, lateral view.
2. Head, en face view (same magnification as fig. 1).
3. Tail of male, lateral view.
4. Tail of male, ventral view.
5. Caudal end of male.
6. Tail of female.

PLATE 2.

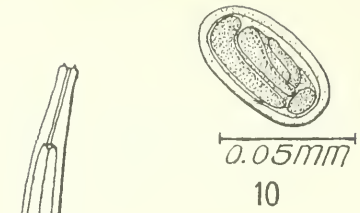
Protospirura columbiana, new species

FIG. 7. Terminal genitalia of female.
8. Vulva and anterior end of vagina.
9. Male and female in copula.
10. Egg.
11. Tail of third stage larva, before encystment.
12. Tail of third stage larva, after encystment.
13. Tail of fourth stage larva.



PROTOSPIRURA COLUMBIANA, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 7



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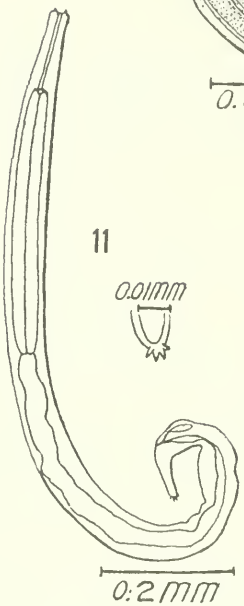

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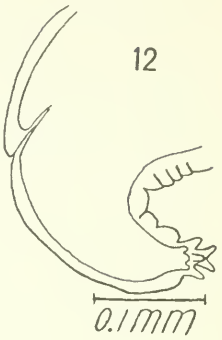

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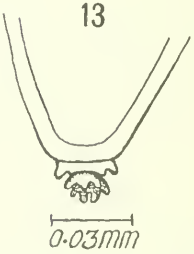

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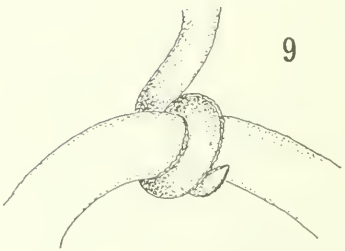

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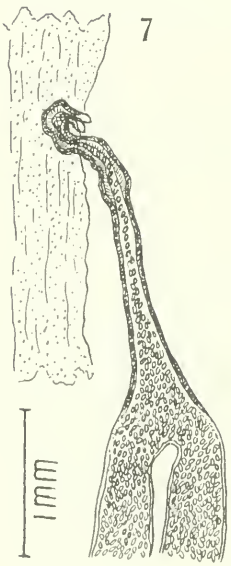

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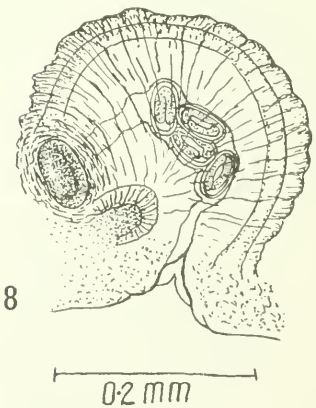

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PROTOSPIRURA COLUMBIANA, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 7

THE NEARCTIC BUDWORMS OF THE LEPIDOPTEROUS GENUS HELIOTHIS

By S. E. Crumb

Of the Bureau of Entomology, United States Department of Agriculture

Larvae of the genus *Heliothis* Ochsenheimer have a marked fondness for the buds, young leaves, and developing fruits of plants and for this reason have been given the name of budworms. The best-known species is the corn earworm, bollworm, or false tobacco budworm (*Heliothis obsoleta* Fabricius). According to Bishopp,[1] the damage caused by this species may be conservatively estimated at $30,000,000 annually. Another important species is the tobacco budworm (*Heliothis virescens* Fabricius), which is a well-known pest of tobacco.

No satisfactory means of distinguishing the species of larvae in this genus has been provided up to the present, since coloration has been depended upon for this purpose and the coloration is extremely variable. Structural characters are provided here by which the species may be positively determined.

GENERIC CHARACTERS

Examination of the four species of *Heliothis* larvae described in the following pages has disclosed the following characters common to the group, which may be considered provisionally as generic characters. It will be noted that the skin is clothed with minute spinules; setae IV and V on the prothorax are in a horizontal plane; and the third joint of the labial palpus is but little if any longer than the second. This combination of characters will serve to distinguish this group from any other larvae known to the writer.

White or yellowish, usually broken, longitudinal lines on the body middorsally, dorsed to setigerous tubercle I, between tubercles I and II, and at the upper margin of the supraspiracular area. Skin clothed with minute spinules. Setigerous tubercles IV and V on the prothorax (on prespiracular shield) in a horizontal plane (fig. 14). Spinneret long and slender, about 5 times or more as long as the median breadth and tapering somewhat toward the apex (fig. 6). Labial palpus with the third segment but little if any longer than the second segment (fig. 5). Blade of the maxillulae with

[1] Bishopp, F. C. The Bollworm or Corn Earworm. Farmers' Bull. 872, U. S. Dept. Agr., p. 3, 1922.

about 9 to 12 flat, toothlike processes on the free margin. Setigerous tubercles of body as in figure 14.

Head setae and punctures as follows: A2 nearer to A3 than to A1; A2 much nearer to Aa than to A1 but often scarcely twice as near; A2 somewhat nearer to A1 than to Pa; Aa twice as near to A2 as to Pa or more; P1 decidedly nearer to Adf2 than to Adf1; P1 somewhat above the level of Adf2; Pa, Aa, and A2 not in a straight line; interspace A2–Aa equalling or slightly less than P1–Pa; Adf2 much nearer to P1 than to P2; Pb about twice as near to P2 as to P1; Adf2 above the apex of the front; P2, P1, and Adf1 approximately in a straight line; Adfa distinctly nearer to Adf2 than to Adf1; O1 posterior to the line connecting the centers of ocelli IV and VI; Oa less than the ocellar width removed from ocellus VI and nearer to the ocellus than to O3; G1 approximately equidistant from SO3 and O3; Ga nearer to G1 than to O3; G1 much nearer to Ga than to SO3; G1 minute.

KEY TO THE SPECIES

1. Dorsal setigerous tubercles (I and II) on abdominal segments 1, 2, and 8 set with the minute spinules with which the skin is clothed. Each mandible usually with a large basal process on the oral face (fig. 9) and with no produced margin along the first ventral rib. Line connecting the bases of setae A3 and O2 passing through ocellus I near the center (fig. 12).
virescens Fabricius.

   Dorsal setigerous tubercles (I and II) on abdominal segments 1, 2, and 8 without spinules. Each mandible with a produced margin along the first ventral rib and without a basal process (fig. 10). Line connecting the bases of setae A3 and O2 passing posterior to ocellus I or tangent to its posterodorsal margin (fig. 2)..... 2.

2. Setigerous tubercles I, II, and III strongly conical and conspicuously large on all abdominal segments. Dark submedian arcs of head very broad, covering all of the head posteriorly..... **phloxiphaga** Grote and Robinson.

   Setigerous tubercles I, II, and III not strongly conical and never conspicuously large except on abdominal segments 1, 2, and 8. Dark submedian arcs absent on the head..... **obsoleta** Fabricius.

DESCRIPTION OF LARVAE

HELIOTHIS OBSOLETA Fabricius

The following distinctive characters of this larva may be noted:

All instars after the second.—Dorsal setigerous tubercles (I and II) on abdominal segments 1, 2, and 8 not set with the spinules with which the skin is clothed, except that rarely there may be a few spinules at the base of the tubercles in adult larvae. Tubercle I on the above segments somewhat larger than II but not conspicuously so. Tubercles not conspicuously conical.

Fifth instar larva.—Head 2.2–2.6 mm. broad.

Adult (sixth instar) larva.—Head 3.3–3.5 mm. broad. A produced margin along the first ventral rib of mandible but no basal process (fig. 10). Spiracles on abdominal segments 1 to 7, 0.222 mm. broad,

which is near the average height of the corresponding spiracles in *virescens* Fabricius (fig. 8). Seta A3 usually distinctly more than the width of the ocellus removed from ocellus II (fig. 2). Line connecting the insertions of setae A3 and O2 passing posterior to ocellus I or tangent to its postero-dorsal margin (fig. 2). Head marked, if at all, with brown freckles and sometimes with white reticulation. No dark submedian arcs.

Body about 0.33 mm. long and 5.5 mm. broad; abdominal segments 1 to 4 of about equal width, the body tapering both anteriorly and posteriorly from these; the skin set closely with small, retrorse, spine-like granules which are white in the pale lines, dark elsewhere dorsally, and pale on the venter; general color varying from red, maroon, orange, yellow, and green to dark fuscous, often green dorsally with a stripe including the pale middorsal line and the supraspiracular area dark. Broken white or yellowish longitudinal lines, often obscure in their relationships, occur as follows: middorsally, bordering the fuscous middorsal stripe, through setigerous tubercle I, between tubercles I and II, through tubercle II, ventrad of II, and several very indefinite in the supraspiracular area. A strong yellow or pale line or narrow stripe margining the supraspiracular area ventrally. Venter tending to be white medially. Spiracles in the subspiracular stripe, black with yellow centres. Setigerous tubercles large and often somewhat conical, I somewhat larger than II on abdominal segments 1, 2, and 8 but not conspicuously so; the tubercles without spinules excepting rarely a few at base. Cervical shield usually with the lateral margins infuscated. Anal shield concolorous with adjacent parts. Head of the general body color, often flecked with brown and sometimes reticulate with white, without fuscous submedian arcs or recitulation. Claw of legs with the base broadly angulate (fig. 4).

Labial palus with the segments in the proportional length of 18, 3, and 4, the basal segment with a long acutely conical papilla apically (fig. 5). Spinneret nearly 6 times as long as the median breadth, tapering toward the truncate apex (fig. 6). Mandible as in Figure 10, the first ventral rib usually produced inward into a thin lobe near the base, or the produced margin may extend along most of the length of the rib. Anterior half of hypopharynx clothed sparsely with very short, stout spines, heavier postero-laterally; lobes of the maxillulae clothed with extremely fine hairs; blade of the maxillulae with about 12 flat, triangular, toothlike processes on the free margin.

Head setae and punctures as follows: A2 distinctly nearer to A1 than to Pa; Aa slightly nearer to A3 than to A2; A3 slightly more than the ocellar width removed from ocellus II; Pa, Aa, and A3 not in a straight line; ocellus VI distinctly nearer to O1 than to O3; O2 nearer to A3 than to L1; O2 slightly nearer to A3 than to O1; L1 distinctly

nearer to La than to O2; SOa usually slightly nearer to SO2 than to SO3; SO3 distinctly nearer to O3 than to G1.

Material.— Described from a large number of larvae from various sources.

Distribution.—This species is widely distributed over the world and is found in nearly all parts of the United States.

Food plants.—The larva is a general feeder. We have not attempted to make a comprehensive list of food plants but have taken larvae feeding on the following: Cotton bolls, ears of corn, buds of corn, tobacco leaves, buds and seed capsules, tomato fruits, peppers, *Physalis*, species, sassafras, rose shoots, beans, and okra.

HELIOTHIS VIRESCENS Fabricius

This larva has the following distinguishing characters:

All instars after the second.—Dorsal setigerous tubercles (I and II) on abdominal segments 1, 2, and 8 set with the minute spinules with which the skin is clothed. Tubercle I on the above abdominal segments usually conspicuously larger than II.

Fifth instar larva.—Head 1.7–2 mm. broad.

Adult (sixth instar) larva.—Head 2.6–3 mm. broad. Each mandible usually with a large basal process on its oral face. Spiracles on abdominal segments 1 to 7, 0.244 mm. high, which is near the average width of the corresponding spiracles in *obsoleta* Fabricius (fig. 7). Seta A3 usually distinctly less than the width of the ocellus removed from ocellus II (fig. 12). Line connecting the insertions of setae A3 and O2 passing through ocellus I near the center (fig. 12). Head marked, if at all, with brown freckles and sometimes with white reticulation. No dark submedian arcs.

Body about 28 mm. long and 4 mm. broad; first four abdominal segments of about equal width, the body tapering both anteriorly and posteriorly from these; skin set closely with small, short, retrorse spinelike granules which are white on the pale lines, dark elsewhere dorsally, and pale ventrally; general color often green with the venter tending to be white medially and with little infuscation, but varying to reddish and maroon with infuscation more or less developed bordering the middorsal pale line and in the supraspiracular area. Broken white or yellowish longitudinal lines usually present as follows: Middorsally, flanking the middorsal line, dorsal to setigerous tubercle I, through tubercle I, between tubercles I and II, through tubercle II, bordering the supraspiracular area above, and a pair in the supraspiracular area submedially. The supraspiracular area is often scarcely differentiated in color from the dorsum but may be more or less intensely infuscated, especially on the dorsal half. Spiracles set well within the subspiracular pale stripe, black with brown centers. Setigerous tubercles large and somewhat conical, I much larger than II on abdominal segments 1, 2, and 8, less

disparity in size elsewhere, both tubercles clothed with spinules especially on the above abdominal segments, color variable, often green with dark tips. Cervical shield usually green flecked with white, the lateral margins sometimes infuscated. Anal shield concolorous with adjacent parts. Head of the general coloration, sometimes with pale brown tessellation and occasionally reticulated with white, no fuscous submedian arcs or reticulation. Claw of legs with the base broadly angulate. Length of segments of labial palpus in the proportion of 16, 4, and 4, the basal segments with a long acutely conical papilla apically. Spinneret about seven times as long as the median breadth, tapering toward the truncate apex. Mandible as in Figure 9, usually with a broad, convex part on the oral face, produced from the base and along the first ventral rib with the broad, often serrate, apex toward the cutting margin of the mandible. Anterior half of hypopharynx clothed sparsely with very short stout spines, heavier postero-laterally; lobes of the maxillulae clothed with extremely fine hairs; blade of the maxillulae with about 12 flat, triangular, toothlike processes on the free margin.

Head setae and punctures as follows: A2 equidistant from A1 and A3, or nearer to A3; Aa slightly nearer to A3 than to A2; A3 less than the ocellar width removed from ocellus II; Pa, Aa, and A3 not in a straight line; Pb scarcely twice as near to P2 as to P1; ocellus VI nearer to O1 than to O3; O2 nearer to A3 than to L1; O2 approximately equidistant from A3 and O1; L1 distinctly nearer to La than to O2; SOa nearer to SO2 than to SO3; SO3 distinctly nearer to O3 than to G1.

Material.—Described from a large number of larvae from Clarksville, Tenn., and Quincy, Fla.

Distribution.—Moths have been seen from Virginia, Tennessee, Colorado, California, North Carolina, Florida, Louisiana, and Mexico.

Food plants.—The known food plants include tobacco buds, leaves, and seed capsules, *Physalis viscosa*, *Rhexia virginica*, *Linaria canadensis*, okra, *Geranium*, and *Ageratum*.

HELIOTHIS PHLOXIPHAGA Grote and Robinson

The following distinctive characters of this larva may be noted: Dorsal setigerous tubercles (I and II) on abdominal segments 1, 2, and 8 not set with the spinules with which the skin is clothed. Tubercle I but very slightly larger than II on the above abdominal segments. Tubercles I, II, and III strongly elevated, conical, on all abdominal segments. Head 2.2–2.5 mm. broad (probably fifth instar). Each mandible with a slight produced margin along the first ventral rib and without a basal process. Spiracles on abdominal segments 1 to 7, 0.22 mm. broad. Seta A3 distinctly more than the width of the ocellus removed from ocellus II. Line connecting the

insertions of setae A3 and O2 passing posterior to ocellus I. Head with conspicuous dark submedian arcs and with some dark reticulation.

Body about 30 mm. long and 4.5 mm. broad, broadest through abdominal segments 2, 3, 4, and 5 and tapering both anteriorly and posteriorly from these; skin set with small, retrorse, spinelike granules which are pale in the pale lines, dark elsewhere dorsally, and pale ventrally, interspersed in dark areas with dark rounded granules; general color green with much infuscation. Longitudinal area between tubercles I occupied by a dark stripe, except for the pale marginal lines and pale flecks representing the middorsal line. The area included between the pale longitudinal line dorsad of tubercel I and the stronger pale line ventrad of tubercle II, dark but much flecked with pale. Below this and including tubercle III a dark longitudinal stripe more distinct than the others and flecked with pale. Spiracles black, included within the pale subspiracular stripe. Venter pale with the setigerous tubercles black as elsewhere. Setigerous tubercles I, II, and III distinctly strongly conical on all abdominal segments, and somewhat larger on abdominal segments 1, 2, and 8. Cervical shield margined laterally with fuscous. Head with but little dark reticulation, the median black arcs very broad, covering the head posteriorly. Claws of legs with the base angulate.

Labial palpus with the segments in the proportionate length of 18, 2, and 3. Spinneret about six times as long as the median breadth, cylindrical. Mandible with only a slight produced margin along the first ventral rib and without a basal process. Blade of the maxillulae with about 11 oblong toothlike projections on the free margin.

In the immature larva setigerous tubercles I and II on the abdomen are remarkably large and conical, the entire head is blackish, and the cervical shield is pale with black lateral margins.

Head setae and punctures as follows: A2 twice as near to A3 as to A1; A2 twice as near to Aa as to A1; A2 slightly nearer to A1 than to Pa; Aa slightly nearer to A3 than to A2; A3 distinctly more than the width of the ocellus removed from ocellus II; Pa, Aa, and A3 approximately in a straight line; ocellus VI distinctly nearer to O1 than to O3; L1 much nearer to La than to O2.

Material.—Described from one mature (?) alcoholic larva and one mature (?) and one immature inflated larva, all in the collections of the United States National Museum. The inflated larvae are labelled "No. 976. Dyar and Caudell Collectors."

Distribution.—Moths have been seen from Texas, Colorado, Utah, and California.

Food plants.—The recorded food plants include: Alfalfa, phlox, grasses, and *Grindilia squarrosa*.

HELIOTHIS CYSTIPHORA Wallengren

This larva is not included in the preceding key to species but may be distinguished by the following characters:

Body gradually decreasing in width from the metathorax posteriorly. Head strongly freckled with dark brown and fuscous, without fuscous arcs or reticulation. Venter with three white lines particularly evident on the first two abdominal segments. Claw of the leg with a long acute basal tooth.

Head 3 mm. broad. Each mandible with a large acute basal tooth on the first ventral rib. Seta A3 not more than the width of the ocellus removed from ocellus II. Line connecting the insertions of setae A3 and O2 passing through ocellus I. Setigerous tubercles of abdomen occasionally with a few spinules.

Body about 25 mm. long and 3.5 mm. broad; skin set closely with small, short, retrorse, spinelike granules; general color apparently grayish with fuscous stripes. A narrow middorsal fuscous stripe including the broken white middorsal line and bordered by white lines. Longitudinal white lines above and below setigerous tubercle I and ventrad of II, this last the strongest. From ventrad of II and including III a fuscous stripe. Spiracles well within the broad pale subspiracular band which extends to tubercle V. Venter with 3 white lines, particularly evident on the first two abdominal segments. Cervical shield strongly bordered with fuscous laterally.

Second joint of labial palpus as long as the third. Spinneret long and slender, five times as long as the median breadth. Mandible with five teeth, with a large acute process on the first ventral rib basally. Anterior half of hypopharynx clothed uniformly with short stout spines of almost uniform size both laterally and medially; blade of maxillulae with about 9 toothlike processes on the free margin.

Head setae and punctures as follows: A2 approximately equidistant from A1 and A3; A2 at least twice as near to A1 as to Pa; Aa equidistant from A2 and A3; Aa three times as near to A2 as to Pa; A3 not more than the width of the ocellus from ocellus II; P1 much above the level of the apex of the front and decidedly nearer to Adf2 than to Adf1; Pa, Aa and A3 not in a straight line; interspace A2–Aa about half P1–Pa; Pb about twice as near to P2 as to P1; Adfa somewhat nearer to Adf2 than to Adf1; ocellus VI equidistant from O1 and O3 or nearer to O3; O2 equidistant from A3 and O1 or nearer to A3; O2 distinctly nearer to A3 than to L1; L1 three times as near to La as to O2; SOa approximately equidistant from SO2 and SO3; SO3 approximately equidistant from G1 and O3

Material.—Described from 4 mature (?) and 2 immature alcoholic larvae in the United States National Museum collection.

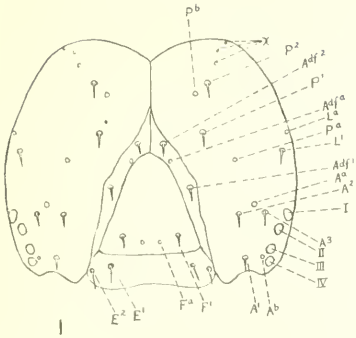
Distribution.—The larvae are from the Galapagos Islands, William Beebe collector. The writer knows nothing of the further distribution of this species.

Food plants.—Unknown.

EXPLANATION OF PLATE

A^1, A^2, A^3, A^a, A^b—Anterior setae and punctures of epicranium.
Adf^1, Adf^2, Adf^a—Adfrontal setae and puncture of epicranium.
E^1, E^2—Epistomal setae.
F^1, F^a—Frontal seta and puncture.
G^1, G^a—Genal seta and puncture of epicranium.
L^1, L^a—Lateral seta and puncture of epicranium.
O^1, O^2, O^3, O^a—Ocellar setae and puncture of epicranium.
P^1, P^2, P^a, P^b—Posterior setae and punctures of epicranium.
SO^1, SO^2, SO^3, SO^a—Subocellar setae and puncture of epicranium.
X—Ultraposterior setae and punctures of epicranium.

1. *Heliothis obsoleta:* Head capsule, dorsal view, showing arrangement of setae and punctures.
2. *Heliothis obsoleta:* Head capsule, lateral view, showing arrangement of setae and punctures.
3. *Heliothis obsoleta:* Head capsule, ventral view of left side, showing arrangement of setae and punctures.
4. *Heliothis obsoleta:* Claw of leg, lateral view.
5. *Heliothis obsoleta:* Labial palpus.
6. *Heliothis virescens:* Spinneret, ventral view.
7. *Heliothis virescens:* Spiracle on third abdominal segment.
8. *Heliothis obsoleta:* Spiracle on third abdominal segment.
9. *Heliothis virescens:* Oral face of left mandible.
10. *Heliothis obsoleta:* Oral face of left mandible.
11. *Heliothis virescens:* Head capsule, dorsal view, showing arrangement of setae and punctures.
12. *Heliothis virescens:* Head capsule, lateral view, showing arrangement of setae and punctures.
13. *Heliothis virescens:* Head capsule, ventral view of left side, showing arrangement of setae and punctures.
14. *Heliothis virescens:* Setal map of first and second thoracic and first, third, seventh, eighth, and ninth abdominal segments.



LARVAL CHARACTERS OF GENUS HELIOTHIS

FOR EXPLANATION OF PLATE SEE PAGE 8

THE MINERALS OF OBSIDIAN CLIFF, YELLOWSTONE NATIONAL PARK, AND THEIR ORIGIN

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INTRODUCTION

This study was undertaken with two objects in view; first, to determine and describe the minerals that are found in the cavities in extrusive volcanic rocks, and, second, to obtain, if possible, information on the character and action of solutions given off by magmas. The results of my study of the minerals of Obsidian Cliff, Yellowstone National Park, are here given, and it is expected that other investigations will follow as material becomes available.

No field examination of the occurence was possible, and this paper is based upon a study of the extensive suite of specimens in the United States National Museum, including the material collected and described by the late Dr. J. P. Iddings.[1] A number of specimens from similar occurrences in California, Utah, Mexico, and Lipari Islands were examined for comparison.

The minerals in the cavities of volcanic rocks may be considered as the final products of chemical reactions, and may be expected to furnish some evidence as to the original nature of the solutions. In the case of flow rocks, the physical environment can be determined with a fair degree of certainty. The physical chemistry of solutions at high temperatures and pressures has been determined to some extent by Smits,[2] Centnerswer,[3] Niggli,[4] and Morey,[5] and will not be discussed at this time.

[1] U. S. Geol. Surv., Mon. 32, pt. 2, 1899.

[2] A. Smits, Zeits. f. Phys. Chem., vol. 51, 1905, p. 193; vol. 52, 1905, p. 498; vol. 54, 1906, pp. 498, 512; vol. 67, 1909, p. 464; vol. 76, 1911, p. 445.

[3] M. Centnerswer, Zeits. f. Phys. Chem., vol. 46, 1903, p. 427; vol. 61, 1908, p 356.

[4] P. Niggli, Neues. Jahrb. f. Min., 1914, p. 69; Zeits. f. Anorg. Chem., vol. 76, 1912, p. 161; vol. 77, 1912, p. 321; also Niggli and Morey, Journ. Amer. Chem. Soc., vol. 35, 1913, p. 1086.

[5] G. W. Morey, Journ. Amer. Chem. Soc., vol. 39, 1917, p. 1174.

OBSIDIAN CLIFF

The Obsidian Cliff, which is so well known for the beauty and delicacy of its lithophysae and the minerals found in them, flanks the road leading from Mammoth Hot Springs to the Norris Geyser Basin, on the west. Iddings describes it as follows:[6]

> Obsidian Cliff is at the northern end of Beaver Lake, in the Yellowstone National Park, about 11 miles south of Mammoth Hot Springs. It forms the eastern wall of a narrow cut in the plateau country through which Obsidian Creek flows at an elevation of 7,400 feet. The cliff extends for half a mile, rising from 150 to 200 feet above the creek and falling away gradually to the north; the upper half is a vertical face of rock, the lower portion a talus slope of the same material.
>
> * * * * * * *
>
> The cliff presents a partial section of a surface flow of obsidian which poured down an ancient slope of rhyolite from the plateau lying to the east. * * *
>
> The exact point at which this obsidian broke through the older rocks and reached the surface has not yet been discovered; but that forming Obsidian Cliff has evidently flowed down from the high plateau in a northwest direction into a preexisting valley, the planes of flow in the lava clearly indicating that it has crept down the slope back of Obsidian Cliff and accumulated in the bottom of a channel between rhyolite hills.

The detailed petrography of this occurrence has been given by Iddings, so it is not my purpose to discuss that phase of the subject; the mineralogy shows some interesting features touched upon but casually by him, and will be considered in this paper.

GENERAL DESCRIPTION OF THE ROCKS OF THE AREA

The rhyolitic rocks of the Yellowstone National Park are wholly extrusive. They are superficial flows in the form of nearly horizontal sheets which vary but little in chemical composition but show a multiformity of physical aspects. Lithoidal and glassy facies are both abundant. The color varies as much as the physical fabric and ranges from a very light gray through shades of gray and brown to black, while some phases are red or mottled, as the variety called marekanite. The rocks are usually porphyritic and, even in some of the hyaline facies, phenocrysts of feldspar or, more rarely, quartz are present. In some areas vesicular or lithophysal rocks are abundant and it is often in these that a variety of minerals of unusual interest is found. These reach their maximum development in the flow making up the Obsidian Cliff and here the relationship of the minerals to one another and to their matrix is most apparent.

OBSIDIAN

The obsidian of Obsidian Cliff is a dark, glassy rock with conchoidal fracture, entirely typical of all other obsidians in appear-

[6] J. P. Iddings, 7th Ann. Rep. U. S. Geol. Surv., 1888, p. 255.

ance, and usually free of phenocrysts, though those found elsewhere in the park show well-formed crystals of feldspar scattered through a glassy groundmass. The rock presents all gradations from that purely hyaline to a lithoidite, with but a minor amount of glass. One of the features to first attract attention is the abundance of stony spherulites scattered through the glass, sometimes singly, sometimes aggregated into bunches, and often coalesced to form well-defined layers parallel to the planes of flow. In some specimens the glass carries hollow spherulites lined with a white coating of crystalline material, either sparsely disseminated or so abundant as to make up the bulk of the rock.

The distribution of the spherulites in zones parallel to the flow structure at once suggests that the glass varies somewhat in its physical or chemical properties. The boundary between the laminae rich in these bodies and those free from them is quite sharp in some specimens and in others gradational. The larger spherulites occupying a position in these bands of stony matter are often semihollow and seem to be the result of spherulitic crystallization that has been carried to a more advanced stage. The luster of the larger ones is dull and the structure more earthy than that of the small, compact bodies, and their entire mass is porous owing to minute, closely-spaced cavities. In these spherulitic bands the small spherulites, joined together to form a line, usually pass through the center of the larger, open bodies, frequently dividing them into halves, and at their intersection, the material of the smaller ones, usually rather glassy, changes to a more granular texture.

Tenne[7] first brought out the fact that spherulites are but special cases of the crystallization of obsidian glass. A comparison of the following analyses given by Iddings[8] will show the chemical similarity of the glass and the spherulites.

Analyses of obsidian and spherulites from Obsidian Cliff

	Obsidian	Spherulites
	Per cent	*Per cent*
Silica (SiO_2)	74.70	76.70
Alumina (Al_2O_3)	13.72	11.98
Ferric oxide (Fe_2O_3)	1.01	1.45
Ferrous oxide (FeO)	.62	.....
Iron disulphide (FeS_2)	.40	.....
Manganous oxide (MnO)	Trace.	.....
Lime (CaO)	.78	.39
Magnesia (MgO)	.14	.....
Soda (Na_2O)	3.90	3.89
Potash (K_2O)	4.02	4.73
Ignition	.62	.66
	99.91	99.80

[7] C. A. Tenne, Zeits. d. Deutsch. Geol. Gesell., 1885, p. 610.

[8] J. P. Iddings, U. S. Geol. Surv., Mon. 32, pt. 2, 1899, p. 426.

LITHOIDITE

Through an increase in the proportion of stony structure, there is a complete gradation of the glassy obsidian into a rock entirely crystalline, though usually microcrystalline—the lithoidite. In this rock the groundmass is partly minutely crystalline, partly aphanitic, and through it are sometimes scattered phenocrysts of feldspar or quartz. The aphanitic facies are colored some shade of brown or dark gray, while the crystalline portions are usually light gray, so that this contrast of colors gives the rock a distinctively mottled appearance. Scattered throughout the mass are irregular cavities lined with minute crystals, causing it to appear rough and harsh to the touch. As the aphanitic portions become more visibly granular, the entire rock becomes more uniformly gray in color, and the irregular cavities give way to those more symmetrical. These cavities are often of extreme delicacy and beauty, especially in those facies of the lithoidite that are decidedly laminated.

Although this rock is usually placed among the rhyolites, it differs from the true rhyolites in its mineralogical composition. It may be chemically classed as a *soda-rhyolite*, but none of the calculated normative minerals of rhyolite are found in its mode. This is brought out by the following analysis by J. E. Whitfield,[9] and the calculated norm and mode of the rock.

Analysis of Lithoidite, Obsidian Cliff

	Per cent
Silica (SiO_2)	75.50
Titanium oxide (TiO_2)	none
Alumina (Al_2O_3)	13.25
Ferric oxide (Fe_2O_3)	1.02
Ferrous oxide (FeO)	.91
Manganese oxide (MnO)	none
Lime (CaO)	.90
Magnesia (MgO)	.07
Lithia (Li_2O)	.06
Soda (Na_2O)	4.76
Potash (K_2O)	2.85
Phosphorus pentoxide (P_2O_5)	none
Sulphur trioxide (SO_3)	.32
Water (H_2O)	.41
	100.05

Norm and mode of Lithoidite, Obsidian Cliff

Norm	Per cent	Mode	Per cent
Quartz	34.2	Tridymite	34.5
Orthoclase	17.2	Natrosanidine	61.6
Albite	40.3	Fayalite	2.7
Anorthite	4.4	Hematite	1.0
Corundum	.6	Hornblende	.8
Hypersthene	1.1		
Magnetite	1.4		

[9] U. S. Geol. Surv., Bull. 150, 1898, p. 160.

Under the microscope the lithoidite has a texture and habit strongly individual and peculiar. It is made up of radiated masses of feldspar needles arranged haphazardly or aligned in rows. The interstices between these masses are in turn lined or completely filled with crystals of tridymite, which is more coarsely crystalline than the feldspar in which it occurs in the form of nests or lenses. Scattered through the rock are well formed crystals of fayalite. The hornblende always forms very minute crystals, which are scattered through the mass or arranged along the flow lines and apparently represent the microlites in the glassy phase of the rock.

Very little of the excess silica shown in the norm is present as quartz, but occurs almost entirely in the form of tridymite, both in the cavities and in the groundmass. The normative albite and orthoclase are largely combined to form sanidine, or, more properly, natrosanidine, while the ferrous iron is contained for the most part in the fayalite. The other constituents are largely in the minute crystals of what is probably hornblende.

LITHOPHYSAE

Both the obsidian and the lithoidite carry abundant hollow cavities lined with crystalline matter. These, for the reason that they suggested bubbles formed by expanding steam, were called *lithophysae* by Von Richthofen. In their simplest form they are hollow cavities in the glassy obsidian, lined with a thin coating of crystalline matter which is shown by close inspection to be made up of minute rods of white or gray feldspar with small pellets of white, waxy cristobalite (pl. 4, fig. 2). The boundary between the glass and the crystalline lining of the cavities is sharply defined and the hollow spheres often break easily from the glass, leaving a smooth, clean cavity. The simple forms become more complex when the crust is made up of partially concentric leaves, or when fibers of feldspar almost completely fill the cavities. In the latter case they approach the solid spherulites in character, although in this type of lithophysae the radial fibrous structure is decidedly more pronounced than in the solid bodies (pl. 4, fig. 3). When the rock becomes more lithoidal, especially in those facies having a banding of glassy and stony matter, the lithophysae increase in size, are irregular in outline, and complex in structure (see pl. 1). It is apparent that the larger lithophysae, like the simpler forms, are intimately connected with the stony spherulites, since they are usually aligned with them and in many cases appear to be but special instances of spherulitic crystallization. Frequently the lithophysae form on only one side of a line of spherulites, but less often on both sides, so that the stony matter passes through the cavity as a median plane without other

change in appearance than becoming somewhat lighter in color and duller in luster.

Although the line of demarkation between the larger lithophysae and the glass is sharp, they can not be removed as easily as can the simpler ones. The material in the larger forms is dull in appearance, radiated textures are not so apparent, and the pellets of cristobalite give way to bright aggregates of tridymite. Well-defined crystals of fayalite are common in this type.

The lithophysae attain their greatest complexity and beauty in the completely lithoidal rock. (See pl. 2.) Perhaps the simplest of the types found are sharply defined circular areas of crystalline feldspar and tridymite that form the walls of flattened cavities. These become more complex through an arrangement of the crystals in concentric rings, as many as 50 of which have been noted in some specimens (pl. 3). Finally, in the most complex types, the growth of these ridges is somewhat similar to that of the petals of a rose.

The materials of the groundmass of the lithoidite and the lithophysae are similar, but the crystals of the latter are much larger and bounded by crystal faces.

In cross section the lithophysae of the lithoidal rock are narrow, lenslike bodies with the concentric rings of crystals on both top and bottom. Some have a flat floor with a low-domed roof in which the rings are on the floor only while the arrangement of the crystals on the roof is entirely haphazard. In general structure the walls are finely laminated and rather sandy with the larger crystals confined to the inner surface of the cavity. In minor details the lithophysae vary greatly, but in general the preceding description covers the main types.

Large, more or less porous spherulites that are obviously transitional between the stony spherulites and the lithophysae, are abundant in the obsidian from the east bank of the Firehole River near the Madison River. These are made up entirely of rodlike feldspar crystals and tridymite plates with occasional intertelluric feldspar and quartz phenocrysts embedded within their mass. They have a rude, concentric structure and usually show large cracks resembling shrinkage cracks, that are lined with loosely coherent, sandlike tridymite crystals. These spherulites appear to be the result of a progressing crystallizing process that started from a nucleus and spread outward through the glass and engulfed some of the phenocrysts.

ORIGIN OF THE LITHOPHYSAE

There have been two general hypotheses proposed to account for the lithophysal structure in obsidians and the materials contained

in them. Von Richthofen[10] first explained them as a result of expanding gas bubbles while the rock was in a molten or plastic state, the disengagement and expansion of the gas being brought about by the release of pressure due to the eruption of the magma. This hypothesis has found supporters in Von Hauer,[11] Zirkel,[12] Weiss,[13] Cross,[14] and Iddings.[15] A second hypothesis is that of Szabo[16] who considered the lithophysae to be the remains of solid spherulites from which much of the material had been removed by chemical means, leaving the lithophysal minerals as an insoluble remainder. This theory was supported by Cole.[17] A chemical examination of these bodies and of the accompanying glass by Tenne,[18] however, demonstrated that they were identical, and, therefore, that no removal of material is involved. The lithophysae are rather a special type of crystallization of obsidian glass.

MINERALS OF THE LITHOPHYSAE

The minerals identified in the cavities and lithophysae of the Obsidian Cliff lavas are, in order of their abundance, feldspar, tridymite, cristobalite, fayalite, and quartz. Numerous minute needles associated with the feldspars may be hornblende.

Feldspar.—In numerous spherulitic lavas, glassy phenocrysts of feldspar are abundant, but this is not the case in the flows of Obsidian Cliff proper. Here the feldspars are largely confined to the spherulties and lithophysae. In the glassy obsidian, the cavities are lined with, or sometimes partially filled by a white, semifibrous coating, which, in the larger cavities becomes more pronounced and under the microscope resolves itself into an aggregate of prismatic orthoclase crystals arranged in parallel position. The constituent groups are sometimes straight, sometimes curved, while occasionally they show delicate branching forms. These feldspar groups are beautiful objects under the microscope (pl. 4, fig. 1), but only in the very coarsest ones can the arrangement be discerned with the naked eye. Twinning is sometimes developed but the twinning law could not be determined with any amount of certainty. The rodlike crystals are terminated by a single glassy crystal that seems to be untwinned. The feldspars in the more glassy portions of the flow contain small white pellets of cristobalite disseminated throughout

[10] F. von Richthofen, Jahrb. k. k. geol. Reichsanstalt, vol. 11, 1860, p. 180.
[11] Karl von Hauer, Verhandl. k. k. geol. Reichsanstalt, 1866, p. 98.
[12] Ferdinand Zirkel, U. S. Geol. Expl. 40th Par., vol. 6, Microscopical Petrography, 1876, p. 212.
[13] Ch. E. Weiss, Zeits. d. Deutsch. Geol. Gesell., vol. 29, 1877, p. 418.
[14] Whitman Cross, Amer. Journ. Sci., ser. 3, vol. 31, 1886, p. 432.
[15] J. P. Iddings, 7th Ann. Rep. U. S. Geol. Surv., 1888, p. 279.
[16] Joseph Szabo, Jahrb. k. k. geol. Reichsanstalt, vol. 16, 1886, p. 89.
[17] Grenville A. J. Cole, Quart. Journ. Geol. Soc. London, May, 1885, p. 162.
[18] C. A. Tenne, Zeits. d. Deutsch. Geol. Gesell., 1885, p. 610.

their mass and scattered over the surface. In the large lithophysae or in the more lithoidal rock the cristobalite is replaced by crystalline aggregates of platy tridymite, and here the rodlike feldspar gives way to rather coarse crystal forms. Where the feldspar crystals are large enough to be determined crystallographically, two types are recognizable. One with the normal prismatic habit has the forms (001), (110), (101), and (100) (fig. 1*a*), and another with an unusual platy habit, is tabular parallel to (001) and has the form (100) absent and (101) reduced to a narrow face or entirely missing (fig. 1*b*). The first type is normal in that the plane of the optic axis is perpendicular to (010) and has a dispersion of ρ greater than v. The second type, which forms beautiful glassy crystals in the lithoidite, is usually much larger than the first, is less abundant, and in most cases the plane of the optic axis is the normal one for feldspar, but at times the sanidine orientation is encountered. 2V is small, v is greater than ρ, α=1.518, β=1.525, γ=1.527. These indices are near those of orthoclase but the analysis given by Iddings shows the crystals to be a sodium-bearing orthoclase with a ratio of Na : K of almost 1 : 1. The crystals show a small extinction angle with the edge *cb* when lying upon the base. They are eminently suitable for optical work and evidence of microperthitic intergrowth, although carefully sought for, could not be found, unless an orthopinacoidal blue chatoyancy is evidence for heterogeneity.

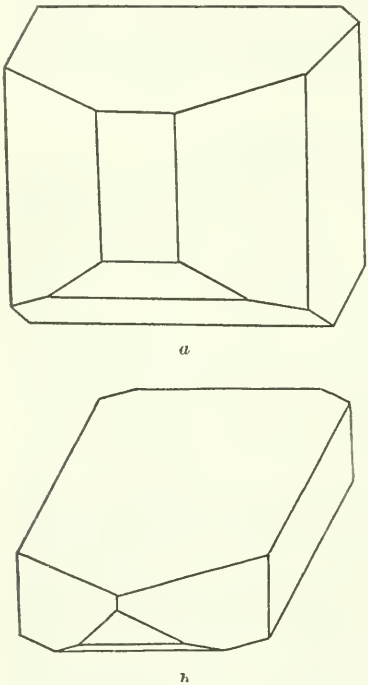


FIG. 1.—TWO HABITS OF FELDSPAR FROM THE LITHOPHYSAE OF OBSIDIAN CLIFF

Tridymite.—Tridymite is very common, not only in the cavities and lithophysae but also in the groundmass of the lithoidite. Practically all of the quartz shown in the norm of the rhyolite appears in the form of tridymite in the mode of its crystalline phase. Large crystals are never found, 0.5 millimeter being perhaps the average size. In the larger lithophysae it is present as simple hexagonal plates and can be readily distinguished from the feldspar, which it often resembles, by its decidedly lower index of refraction. Tridymite plates in parallel position are common, but twins are rare if not entirely absent. This is rather remarkable when the rarity

of single crystals in the many other occurrences where twins are the rule is noted.

In the large, hollow spherulitic lithophysae, composed of fibrous feldspar and tridymite the latter mineral is usually grouped in spherical aggregates resembling the cristobalite pellets but with a rough surface and more vitreous luster. These groups of tridymite are attached to the feldspar rods and project into the cavity or into the spaces between the crystals of feldspar. One gains the impression from an examination of this occurrence that the tridymite is a somewhat later formation than the feldspar. In the lithophysae of the lithoidite also the tridymite appears to be later than the feldspar since it forms radiating groups of plates perched upon stubby feldspar crystals (see fig. 2, and pl. 4, fig. 4). In the cracks of the large spherulites of the Firehole River obsidians, the tridymite is dusted over the surface and is undoubtedly the last mineral to form. Some of these masses of radiating rods carry phenocrysts of quartz and feldspar of intertelluric origin which are likewise dusted over with tridymite plates where they project into a crack. Apparently the feldspars of these bodies grew rather rapidly while the tridymite formed more slowly.

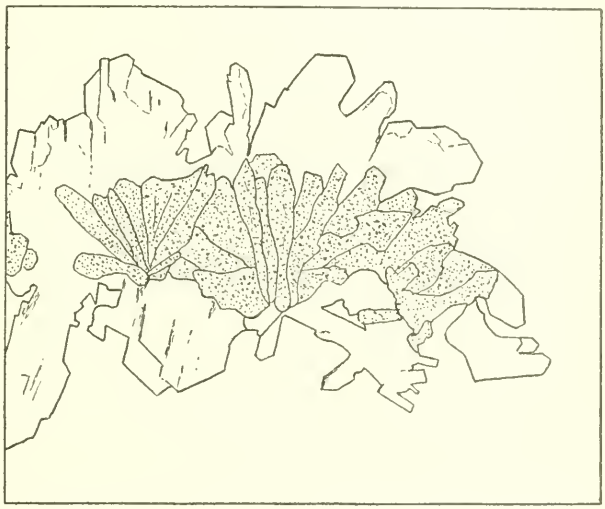


FIG. 2.—SECTION OF RING IN LITHOPHYSAE SHOWING THE RELATION OF THE TRIDYMITE (WHITE) TO THE FELDSPAR (STIPPLED). CAMERA LUCIDA SKETCH. ×40

Cristobalite.—The cristobalite is found only in cavities in the wholly glassy rock where it is abundantly, though not always conspicuously, associated with feldspar. It is never found with the coarser feldspar crystals and is evidently confined to the upper and thinner portions of the flow. It forms small white pellets smoother than those of the tridymite groups, which are scattered over the surface or through the body of the feldspar crusts (pl. 4, figs. 2 and 3). Clear, honey-yellow crystals of fayalite are often associated with it. Under the binocular microscope the cristobalite shows a fine, drusy surface made up of crystals which are usually too small

to distinguish except through high magnification. The larger groups are white and have a waxy luster, while the smaller ones are somewhat more translucent. The groups are irregularly rounded and show no suggestion of crystal form.

Under the microscope the pellets of cristobalite are seen to be made up of radiating laths with low birefringence. The surface is composed of minute octahedral or larger dodecahedral crystals, the latter being usually flattened and very much resembling the hexagonal plates of tridymite, from which they can be distinguished only by their higher indices of refraction. The mean refractive index of cristobalite is 1.486 with a birefringence too low to give a recognizable interference figure, and in thin sections is so feeble that close inspection is necessary to differentiate it from glass.

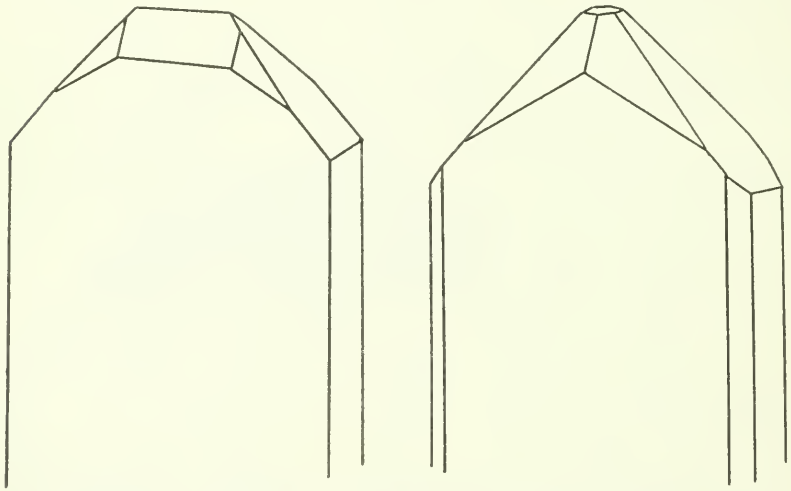


FIG. 3. CRYSTAL HABIT OF FAYALITE FROM THE LITHOPHYSAE OF OBSIDIAN CLIFF

The optical properties and general physical appearance of the cristobalite are near those of the tridymite, and the similarity is heightened by the presence of the cristobalite as flattened dodecahedral crystals showing angles of 120 degrees. This striking similarity raised a doubt as to the actual presence of two distinct minerals in the rocks. A sample of the white pellets was submitted to R. W. G. Wyckoff of the geophysical laboratory, Carnegie Institution of Washington, for X-ray examination. His comparison of its pattern with that of the synthetic form, definitely determined the mineral to be cristobalite.

Fayalite.—Fayalite is present in all parts of the flow, but never in abundance. Fresh, unaltered crystals, a millimeter or less in length and of a fine, honey-yellow color, are found in the upper portions of the flows in association with cristobalite and fibrous

feldspar. Their small size and light color makes them inconspicuous objects which are easily overlooked. In habit they are flat plates tabular to the macropinacoid (100) with the edges modified by narrow faces of (120), (111), (101), and (010) (figs. 3, 4). The indices of refraction are high. The crystals are weakly pleochroic; Y is light brown, X light grayish brown. The optical orientation is X=b, Y=c, Z=a; the broad front pinacoid gives an obtuse bisectrix figure with the plane of the optic axis parallel to the base.

The larger lithophysae of the glassy rock contain fayalite crystals that are larger and stouter, and with a fine chestnut brown color. Many of them have a red and green iridescence on the surface, giving a metallic sheen. These larger crystals, under the microscope,

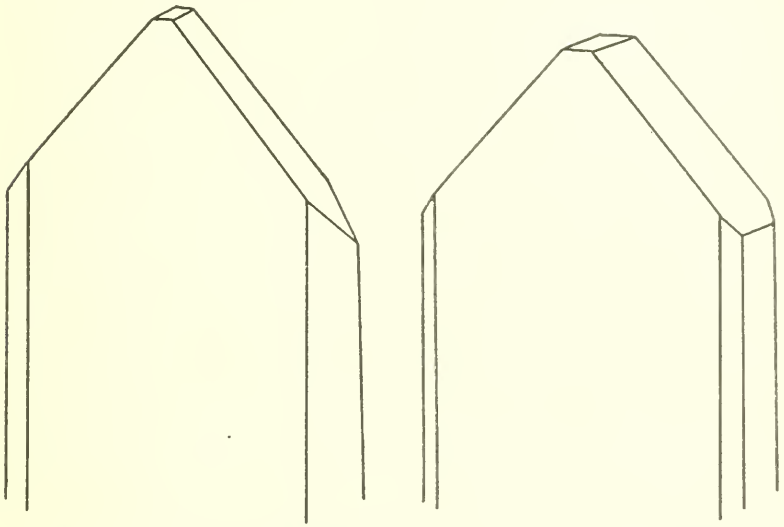


FIG. 4.—CRYSTAL HABIT OF FAYALITE FROM THE LITHOPHYSAE OF OBSIDIAN CLIFF

have the same optical properties as the smaller, except that the pleochroism is fainter in shades of chestnut brown. Many of the crystals show a coarse cross grating on the surface, the lines being parallel to the faces (010) and (001), apparently due to cleavage.

The fayalite crystals are exceptionally sharp and the faces bright. The measured angles are as follows:

Measured angles of fayalite crystals

Face	φ	ρ
001		0
010	0	90
100	90	90
101	90	51° 33′
120	47° 16′	90
031	0	49° 10′
111	65° 22′	54° 00′

Fayalite is also present in the lithophysae of the lithoidite where the crystals are somewhat more prismatic in habit and are usually wholly or in part altered to hematite. In all cases it forms larger crystals than any of the associated minerals.

Quartz.—Quartz is not uncommon as phenocrysts in some of the Yellowstone rhyolites but is far less abundant than feldspar. In the lavas of Obsidian Cliff, however, it is absent except for minor amounts in some of the lithophysae of the lithoidite where it occurs as small prismatic crystals. In one specimen a cavity carried small crystals of quartz with small plates of tridymite dusted over them. These quartz crystals are trapezohedral in type and hence apparently of the low temperature form.

DISTRIBUTION OF THE MINERALS

The relation of the minerals to their position in the flow was not studied in the field, but certain associations suggest a vertical distribution. Iddings describes the surface of the flow as pumiceous, passing in depth into a glass rich in cavities but barren of minerals. Below this is a zone of glass carrying simple lithophysae made up of fibrous feldspar and cristobalite. As more stony matter is encountered, corresponding to greater depths, the lithophysae become larger, the feldspar crystals stouter, and the cristobalite is replaced by tridymite. This phase passes over to the lithoidite (representing a still deeper zone) in which the feldspar occurs in well-defined crystals and the tridymite as large, single individuals. Presumably the quartz-bearing lithophysae are from the lowest or thickest parts of the flow, but hand specimens do not show any direct evidence of this. Fayalite is present in all zones; in the upper it is clear yellow to brown and is fresh, while in the lower it is wholly or in part altered to hematite.

The type of silica mineral to form seems, therefore, to be dependent upon the position within the flow. Since the comparatively slight increase in pressure in such a flow would produce but a negligible effect upon the silica inversions involved, and since the temperature of consolidation in different parts of the flow was essentially the same, some other factor has determined which form shall be produced. As we are dealing with the metastable forms, the time factor may have been an important one.

TEMPERATURE OF FORMATION OF THE MINERALS

In a specimen of the hyaline obsidian carrying numerous lithophysal cavities (No. 2235 of the Iddings Collection), a small tongue of glass several millimeters long and shaped like a fish-hook projects through the crust into the cavity. This tongue is similar to those

described by Wright[19] from Hrafntinnuhryggur, Iceland. It has a double significance in demonstrating that the crystals formed while the glass was still somewhat viscous, while its distinctive fish-hook shape suggests that it was forced into the cavity by pressure. Thus, though still rather viscous, the preservation of the delicate structure of the lithophysae shows that the mass must have been essentially at rest. The temperature of formation then must have been somewhere near the point of solidification of the glass. Brunn found that obsidian from Lipari no longer flowed at 800° C. For a fresh magma still charged with volatile constituents, the temperature must be somewhat lower. In some specimens of lithophysae, trapezohedral quartz takes the place of the more common tridymite as an apparently primary crystallization. These facts would suggest a temperature of formation of the minerals as somewhere in the neighborhood of 500° C. This is, of course, much below the quartz-tridymite and tridymite-cristobalite inversion points,[20] and the last named minerals must have formed as unstable phases.

ORIGIN OF THE MINERALS

The first mode of origin that suggests itself is the transportation of the materials in aqueous solution from the outside into the cavity, much after the manner in which zeolites are formed. Because of the relatively slight solubility of these minerals, even at somewhat elevated temperatures, a considerable volume of solvent would be required. Glass is easily susceptible to hot aqueous solutions and if the origin of the minerals had actually occurred in this manner, a decided alteration would be apparent. The glass, however, is perfectly fresh to the very walls of the lithophysae. If aqueous solutions were inadequate, then perhaps the materials were transported in gaseous solution whose mineral content was in the form of easily volatile compounds. But such a process involves an abundant supply of fluorine, chlorine, or other mineralizers, and, although sought for, no evidence of these constituents in any large quantity was found.

It is difficult to conceive any origin whereby the materials were introduced into the cavities from outside, or to escape the conclusion that the materials making up the minerals originated within the cavity itself. Iddings[21] has already pointed out that "these lithophysae, composed of prismatic quartz, tridymite, soda-orthoclase, fayalite, and magnetite (to which should be added cristobalite), are of aqueo-igneous origin and have been produced by the action of the

[19] F. E. Wright, Bull. Geol. Soc. America, vol. 26, 1915, p. 255.
[20] Clarence N. Fenner, Amer. Journ. Sci., vol. 36, 1913, p. 331.
[21] J. P. Iddings, 7th Ann. Rep. U. S. Geol. Surv., 1888, p. 283.

absorbed gases upon the molten glass from which they were liberated during the crystalization consequent upon cooling."

Below is given the normative composition of the glass, spherulites, and lithophysae, calculated from the analyses given by Iddings,[22] a comparison of which will show the close relationship between them and immediately suggest the origin of the minerals from the glass.

Normative composition of obsidian, spherulites, and lithophysae

	Obsidian	Spherulites	Lithophysae
	Per cent	*Per cent*	*Per cent*
Quartz	36.72	33.48	37.32
Orthoclase	21.68	27.80	23.45
Albite	33.01	32.48	35.63
Anorthite	3.89	.95	1.11
Corundum	2.24		0.41
Hypersthene	0.30		
Magnetite	0.28		
Hematite	1.60	1.44	1.44

These bodies, are in fact, as other investigators have pointed out, but special types of crystallization of obsidian. It only remains to determine the mechanics of a crystallization that will give rise to unstable forms of silica and the other characteristic features of lithophysal structure.

We have already seen that the lithophysae are closely related to the spherulites. Since they are but one step advanced, they must have their beginnings in spherulitic crystallization. Iddings has shown that the crystallization of the spherulite began in the separation of a microlite from which the further crystallization proceeded in all directions. If its environment was rich in dissolved water, this would be liberated and begin its work of solution immediately. The glass, being easily soluble, will be readily attacked, but a saturated solution of glass will be supersaturated with respect to the crystalline phases and one or more of them must crystallize out. In Figure 5 the relation of the silica minerals to temperature and solubility is given. The actual value of the solubility of these minerals is of course not known, but their relative solubility is known from their stability relations. Glass, being the least stable, is the most soluble, followed in turn by cristobalite, tridymite, and, finally by quartz, the stable phase, which is the least soluble. A solution at the temperature and concentration X (fig. 5), for instance, in contact with glass, would then be supersaturated with respect to all the crystalline phases of silica; cristobalite, tridymite, and quartz, and one or more of these must separate out in crystalline form. The fact that all three crystalline phases are apparently stable in contact with each

[22] 7th Ann. Rep. U. S. Geol. Surv., 1888, p. 291.

other suggests that the solubility curves do not lie very far apart, for the rate of transformation of an unstable to a stable phase is dependent upon their relative solubilities. A great difference in solubility brings about a rapid transformation to the stable phase. The difference in solubility as shown by the curves in the diagram is, therefore, probably somewhat exaggerated.

The form which actually separates out is, in the absence of nuclei, determined by which ever nucleus first forms. It is obviously necessary for the solution to be supersaturated with respect to the stable phase before the less stable form can possibly separate out. Further, the unstable forms are likely to appear only if their solubility is not greatly different from that of the stable forms. This is a further indication that the solubility of the silica minerals is

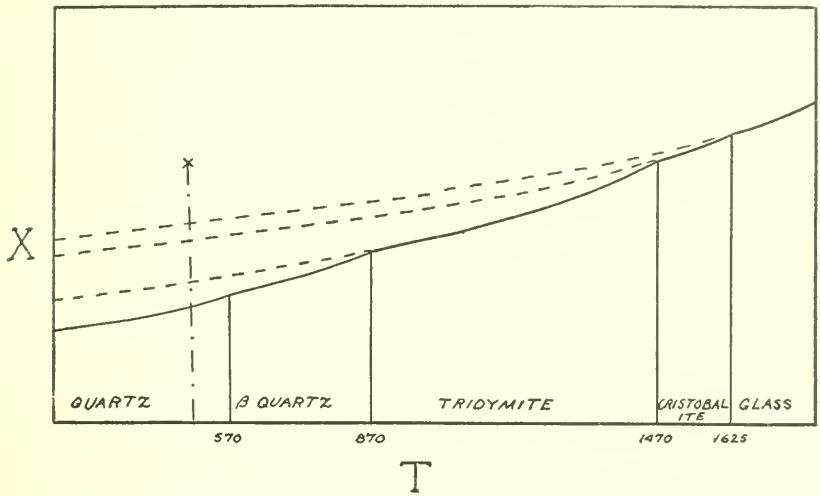


FIG. 5.—DIAGRAM SHOWING RELATIVE SOLUBILITY OF THE FORMS OF SILICA

not very greatly different. In fact, judging from the ease with which the unstable phases of silica form, their solubility is very nearly the same. If this actually be the case, it may even be possible for the unstable phase to form in equilibrium with the stable, provided the former produces large crystals while the latter separates as very fine particles. This apparent ambiguity is due to the fact that the smaller particles have a higher vapor tension and hence a greater solubility than the larger, and may even equal in solubility the larger crystals of the unstable phase. This, of course, can only happen if the solubility of the two phases differs but slightly.

It is well known that the various allotropic modifications may be obtained from a solution by merely varying the conditions of crystallization. The theory of allotropy proposed by Smits[23] is based

[23] A. Smits, Zeit. Physik. Chem., vol. 82, 1913, p. 657.

upon the idea that the different modifications are all present in the solution in equilibrium with each other. In the supersaturated solution it is possible for the metastable nucleus to be first formed. If the rate of change to attain equilibrium is small or if cooling is sufficiently rapid, or if both of these conditions maintain, it is easily possible for an unstable form to separate out. To some extent, therefore, the phase to form is conditioned by the rate of cooling. From Ostwald's principle of the succession of the phases of a metastable system, we would expect to find a tendency for the silica to pass from glass through the intermediate unstable phases cristobalite and tridymite to reach the stable form quartz. In that portion of the flow where the escape of the solvent was rapid, the least stable crystalline phase, cristobalite, could form, and, in the absence of prolonged action, persist. Where the action of the solvent is continued for a longer period, the somewhat more stable form, tridymite, could form, and, finally, where the action is of sufficiently long duration, the stable form quartz might be attained. This does not imply that cristobalite is first formed to be later transformed into tridymite and quartz, for this certainly is not the case. The various forms of silica once produced, persist with great tenacity, and the use of mineralizers is usually required to change one into the other.

Whether the solution attacking the glass was liquid or gaseous can not be determined with certainty. At the low pressure and comparatively high temperatures prevailing, they were probably gaseous. The thickness of lava above the solutions was not sufficiently great to cause pressure high enough to keep the solutions liquid at the temperature of the flow, and the slight concentration of the solute probably had only a small, perhaps negligible, effect upon the boiling point of the solution. Just how competent gases are to dissolve silicate glass at a temperature of about 500° C. can not be told precisely at this time, but undoubtedly some solution does take place. Certain lines of evidence indicate that the solubility of silica in gaseous water may be fairly great at comparatively low temperatures. The solubility, however, need not be great nor the amount of solvent large, for the solvent in a case such as this simply acts as a catalyzer. Its action is continuous. As rapidly as the crystalline phase separates from its supersaturated solution, the solvent is capable of dissolving more glass, this process continuing until the transformation is complete or until the escape of the solvent stops the reaction. In this manner the final effect of a small amount of solvent can well be the transformation of a considerable bulk of glass into crystalline matter.

The feldspars have apparently separated from the solutions before the quartz, tridymite, cristobalite, or fayalite, for invariably these last minerals are perched upon the feldspar crystals. They

are, too, large and more perfectly developed. This suggests also that iron and silica are comparatively more soluble under these conditions than the feldspar. It is interesting to note that Niggli[24] found that crystals forming in the "pq region," that is, by direct crystallization of the solid phase from the gaseous solution, were many times larger than those formed from the liquid solution. Larsen[25] noted that in the rocks of the Creede District the quartz and orthoclase formed nests in a fine grained groundmass in which these later minerals were enormously larger than those of the groundmass, a condition again suggesting that the crystals were formed from gaseous solution.

RELATION OF WATER TO THE CRYSTALLIZATION OF FLOWS

The effect of dissolved gases to reduce the viscosity of a melt and thus to favor crystallization is already well known. The solvent action of the escaping gases upon the glass, with its concomitant separation of crystalline phases has not been emphasized as a means of bringing about a crystalline mass. It seems probable that the action of what appears at first sight to be an almost insignificant amount of water vapor upon highly acidic rocks, like those of Obsidian Cliff, can, under favorable circumstances, cause an almost complete crystallization. There are several facts that seem to bear out the importance of this action. First there is the prevalence of tridymite and cristobalite in the acidic flow rocks, not only in the cavities but in the groundmass as well. This fact was first clearly brought out by Larsen.[26] In his studies of the rocks of the Creede District he showed that these two minerals were relatively more important than quartz. The inconspicuousness of both in thin section have made them easily overlooked and their presence is probably more widespread than is generally believed for it is only recently that the wide distribution of these minerals has been recognized. The second fact is the characteristic structure of many of the rhyolites and related rocks that manifests itself in a rough appearance and feeling of harshness, due to the numerous small cavities lined with tridymite and feldspar crystals. The well-known tendency of anhydrous melts of silica and the alkali feldspars to form glass rather than to crystallize, suggests that the mineralizers are a most important factor in bringing about crystallization in acidic flows. It might be mentioned also that in some of the most successful mineral syntheses, the action of water vapor upon glasses has been employed. It therefore appears that this

[24] P. Niggli, Centr. f. Min., Geol. u. Pal., 1912, p. 331.
[25] E. S. Larsen, U S Geol. Surv., Bull. 718, 1923, p. 21. See especially plate 6, fig. A.
[26] Idem, p. 47.

action of gases upon viscous melts or glasses is of primary importance in bringing about the crystallization of the lavas, and may, in fact, be largely responsible for the crystalline character of their flows.

DESCRIPTION OF PLATES

PLATE 1

Large lithophysae and spherulites in obsidian glass. These lithophysae are made up of feldspar rods and globular aggregates of tridymite crystals.

PLATE 2

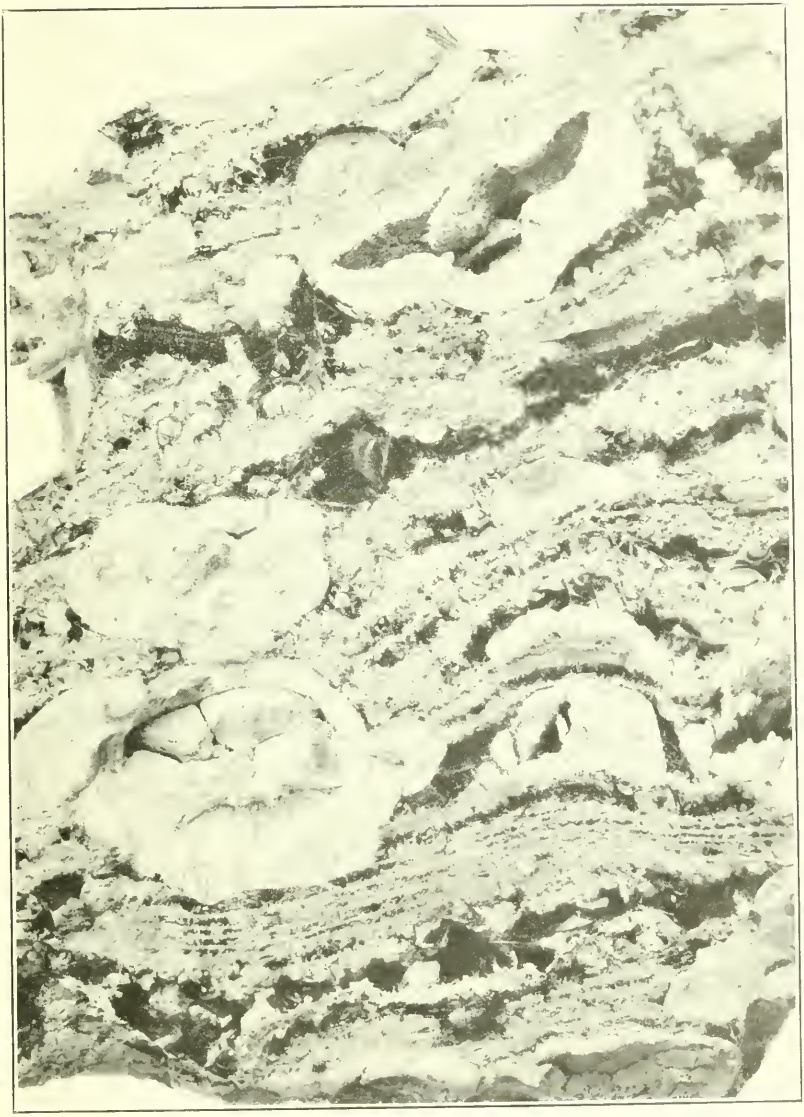
Lithoidite showing different forms of lithophysae. These lithophysae are made up of sanidine and tridymite. The black crystals scattered through the lithophysae are fayalite.

PLATE 3

Lithophysae in lithoidite with numerous rings. The rings are made up of tridymite and feldspar, while the black crystals are fayalite.

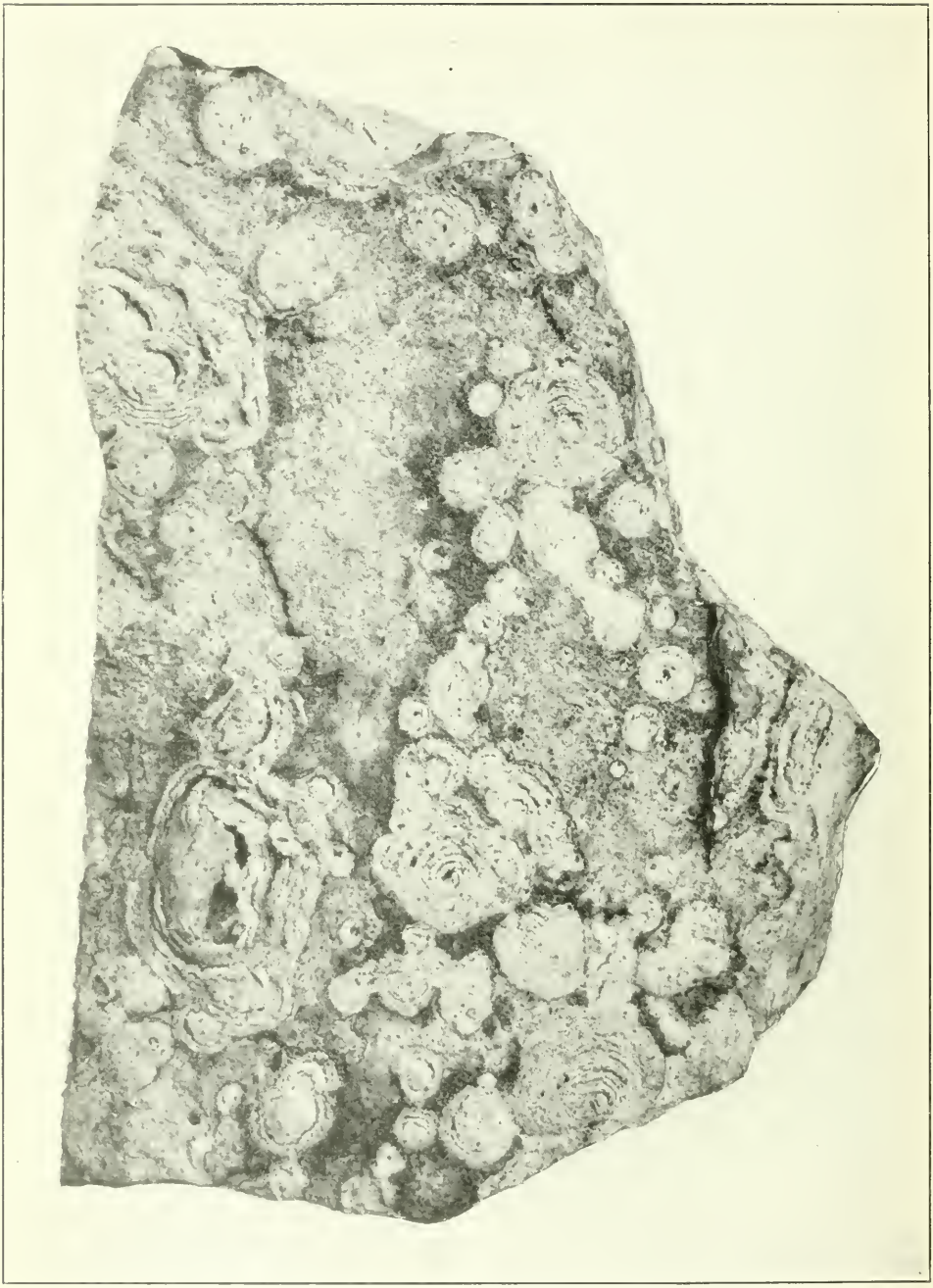
PLATE 4

FIGS. 1. Feldspar crystals in parallel growth, out of lithophysal cavity. (× 40)
2. Cristobalite pellets in lithophysal cavity. (× 6)
3. Cristobalite pellets and feldspar rods in small lithophysae. (× 6)
4. Tridymite, feldspar, and fayalite in small lithophysae. (× 6)



THE MINERALS OF OBSIDIAN CLIFF

FOR EXPLANATION OF PLATE SEE PAGE 18



THE MINERALS OF OBSIDIAN CLIFF

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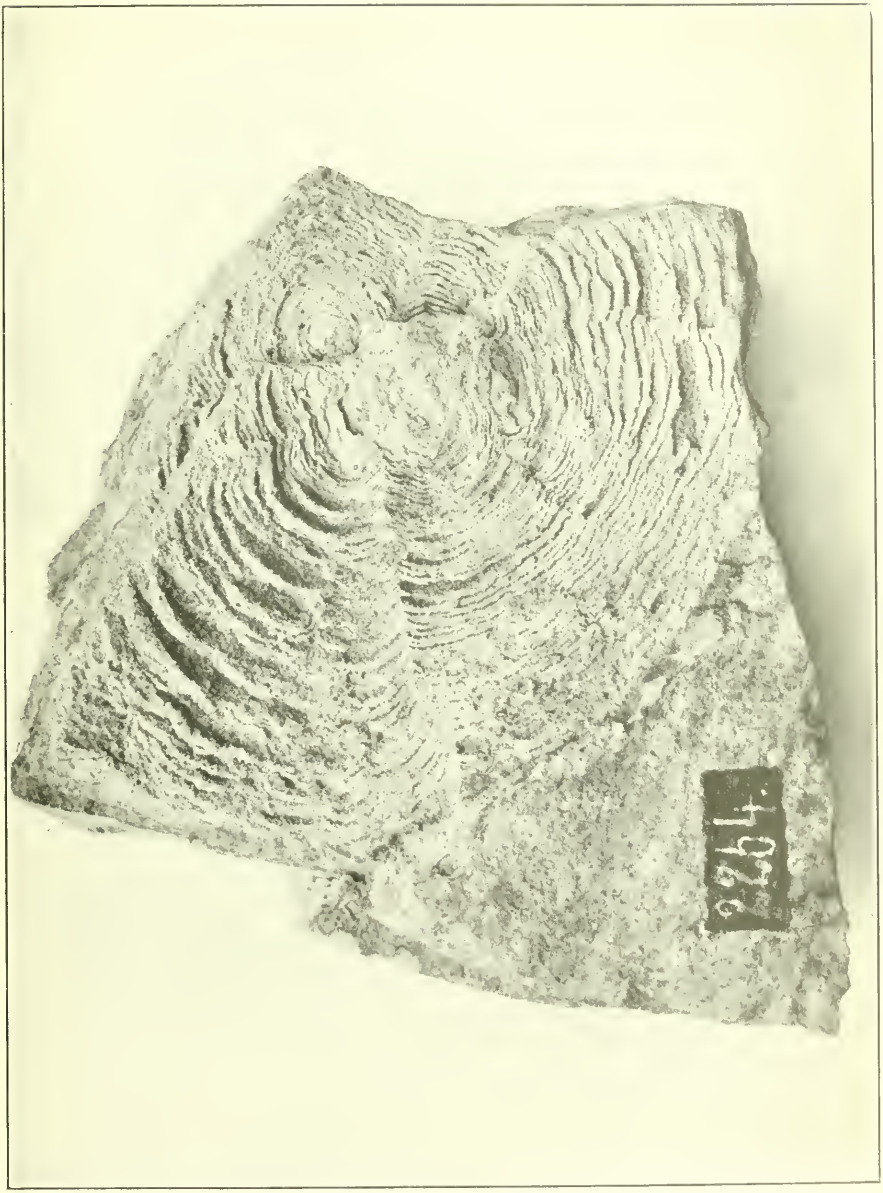

THE MINERALS OF OBSIDIAN CLIFF

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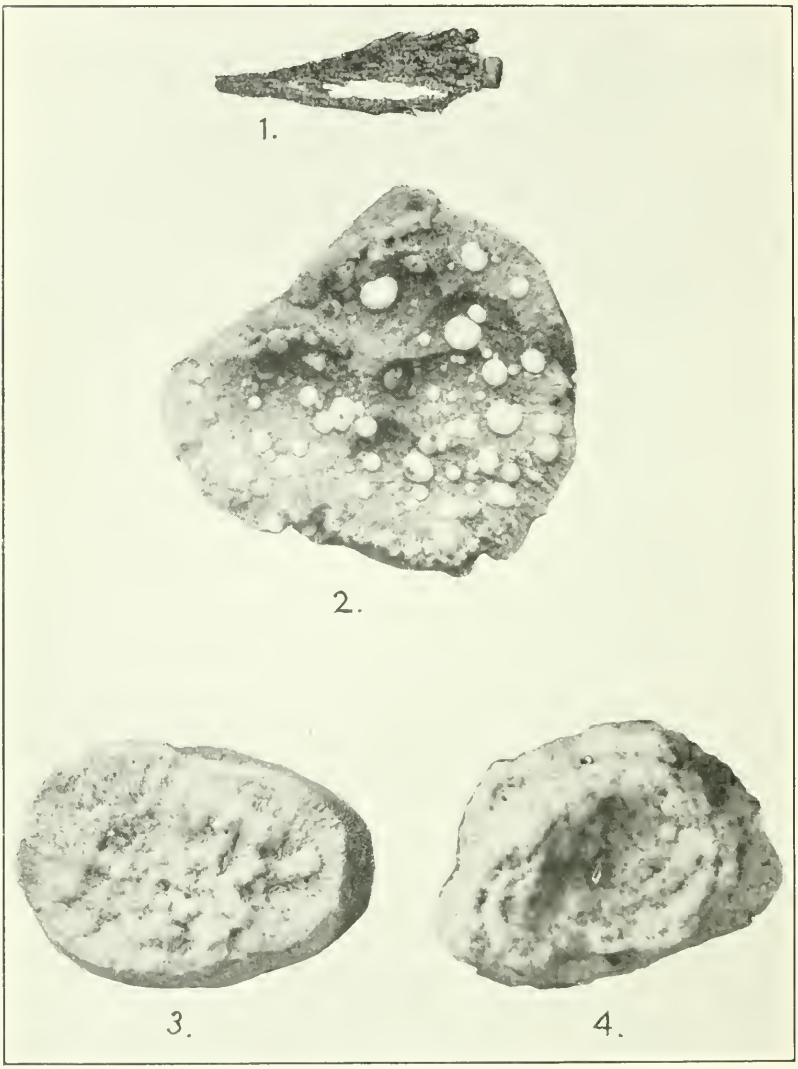

THE MINERALS OF OBSIDIAN CLIFF

FOR EXPLANATION OF PLATE SEE PAGE 18

REVISION OF THE AMERICAN LEAF HOPPERS OF THE JASSID GENUS TYPHLOCYBA

By W. L. McAtee

Of the United States Biological Survey

INTRODUCTION

The genus *Typhlocyba* is one of a group of leaf hoppers which seem naturally allied by their small size, frail structure, reduction of tegminal venation, and usual absence of ocelli. However, the most appropriate rank for this group, and its definition, are debatable points. Certainly prior definitions of what is here called the subfamily Eupteryginæ including that [1] of the present writer must be abandoned. Contrary to previous conceptions certain members of the group have ocelli,[2] and others have anteapical cells in the tegmina.[3] There is no basal sutural line defining the front from the vertex and the lateral sutural lines bounding the front are evanescent basally. In Baker's key of 1923 [4] the members of this group run to the family Jassidæ. What the scope of the group should be, and its proper definition are matters of far from exact knowledge at present. However, the general characters mentioned in the first sentence and the reduction of claval veins to one or usually to none are aids to recognition of the leaf hoppers we now call Eupteryginæ.

For recognition of the genus *Typhlocyba* within the subfamily the following characters should be verified: Wing has two apical cells and no submarginal vein; tegmen has no appendix, nor anteapical cells, the third apical vein curves so as to join radial margin of tegmen about half way between fourth crossvein and apex of tegmen and the second apical cell usually is more or less stalked (pl. 1). The vertex usually is between rounded and angulate, and

[1] Proc. Biol. Soc. Wash., vol. 31, p. 110, November, 1918.

[2] McAtee, W. L., Florida Entomologist, vol. 8, Nos. 3–4 (December, 1924), February, 1925, pp. 34–35.

[3] Baker, C. F., Psyche, vol. 8, p. 403, September, 1899.

[4] Baker, C. F., Philippine Journ. Sci., vol. 23, No. 4, pp. 351–353, October, 1923.

coloration is rather plain. Numerous species are whitish to yellowish without markings, several have dark markings, and only a few show any other colors.

The scarcity of external features upon which classification might be based suggested appeal to the characters of the genitalia. The aedeagus assumes a remarkable variety of forms, but its structure is very constant for each species. The shape of the eighth sternite of the female also is helpful in segregating species, but is more limited in diversity.

TECHNIQUE OF GENITALIC STUDY

Remove the entire abdomen; this is easily done by applying pressure at the base while the specimen is held back down on a cork or other support under a low power of the binocular microscope. The abdomen is more readily severed at the base than elsewhere and usually can be removed without otherwise damaging the specimen. A great advantage in removing the entire abdomen is securing a sizable object to work with; the hypopygium alone is small and more easily lost, and the abdomen makes a convenient handle for it in consequent manipulations. Before proceeding further observe, describe, and draw if necessary, the external features of the genitalia. These are more easily made out in dry than in cleared specimens. For identification all that is necessary in some cases is to flip off (by a forward and lifting pressure with a needle) the anal tube. The apex of the aedeagus often is thus exposed fully enough for its characteristic shape to be observed without further dissection. When it is desired to go further place the specimen in saturated solution of potassium hydroxide in a small beaker or test tube and gradually bring to the boiling point. This is sufficient clearing for most specimens; in fact a litle shorter exposure to the reagent will serve in many cases. A fine needle or pin, hooked and mounted in a handle, is convenient for transferring the specimen to and from the reagent. Upon removal place the cleared abdomen in glycerine, using a slide with a concavity or cell ground in it. Under a moderate power of the binocular examine for additional details of external structure and add to or amend the notes previously made. This accomplished, tease the hypopygium with fine needles so as to loosen and draw out the aedeagus, but not to disconnect it. These organs are very minute and if separated are likely to be lost; it is well, therefore, to keep them attached to large "handles." Observe the natural relationship of the parts, and describe and draw them in natural positions. Flattening them out under cover glasses is very inadvisable. The genitalia can be studied in a drop of glycerine under powers of the microscope as great as are needed. If high

lights interfere add more glycerine to keep the specimen completely submerged. For drawing it is desirable sometimes to hold the parts in a fixed position. This can be done with glycerine jelly. Slightly warming the jelly fits it for reception of the specimen which can be manipulated into the desired position with needles (warmed if necessary). The jelly will gradually set and when it seems assured that the specimen will retain its position, the slide can be laid on some cool object to complete the hardening process. To avoid losing the connection between the treated hypopygium and the insect from which it was removed, the writer transfers them from the slide to a drop of shellac on the same card point on which the insect is mounted. The glycerine and shellac seem to form a persistently viscous combination, from which the specimen can be removed at will for further examination, and which is transparent enough to permit seeing details sufficiently in many cases so that removal is unnecessary. How long this desirable consistency of the mounting medium will persist is unknown, but if a solvent is needed, alcohol which can not injure the specimen will serve the purpose.

TECHNIQUE FOR DRAWINGS AND REPRODUCTIONS THEREOF

Whether made by the aid of the binocular or the monocular microscope, drawings are scaled by a grid-ruled micrometer and drawn on graph or profile paper. The divisions on both the micrometer and the paper being on a decimal system, proportions of the drawing take care of themselves. Details also are traced easily and quickly even by one not especially proficient in drawing. Use profile paper with faint blue ruling; ink in the drawing with rather heavy lines and have about half of the reduction ultimately desired made by photography. The blue lines are thus eliminated, the drawing standing out well on a nearly white background. By this process the operations of tracing and redrawing the figures are eliminated.[5] Another way in which the same economy of effort may be had is to make the drawing directly on tracing paper held stationary over a sheet of profile paper.

NOMENCLATURE OF THE GENITALIA

The nomenclature for the parts of the genitalia are partly adapted from those used by Lawson[6] and Brittain[7] and partly improvised.

[5] Using the technique described in this and in the preceding section, the writer is able to clear and describe a hypopygium and make all drawings required for one species in an hour, and to do all work necessary to identification of a previously known species in from 10 to 15 minutes.

[6] Kans. Univ. Sci. Bull., vol. 12, 1920, pp. 44–52.

[7] Proc. Acadian Ent. Soc., No. 8, 1922, pp. 62–66.

Their application is shown in figures 40, 41, and 110, and their equivalents in the following table:

MALE (FIGS. 40 AND 41)

Terms in this paper		Equivalents
Ninth segment	(a)	Pygofers (the plural is incorrect.)
Anal tube	(b)	Anal tube.
Outer clasper	(c)	Plates.
Inner clasper	(d)	Styles, gonostyli, parameres.
Connective	(e)	Connective.
Aedeagus	(f)	Same term spelled in various ways; penis.

FEMALE (FIG. 110)

Ninth segment	(a)	Valvifer.
Anal tube	(b)	Anal tube.
Ovipositor sheath	(c)	Valvulæ.
Eighth sternite	(d)	Genital plate; ultimate ventral segment.

RELATION OF THE GENITALIA IN COPULATION

In copulation members of the genus *Typhlocyba* assume a tail to tail position. The entire hypopygium of the female is elevated, as is also the anal tube of the male. The upper posterior angles of the ninth segment (often toothed within) of the male press against the sides of the female hypopygium. The outer claspers extend over, and the inner claspers under the eighth sternite of the female. The aedeagus is inserted into the ninth segment just behind and above the eighth sternite (fig. 110).

SOURCES OF MATERIAL

Besides the collection of the United States National Museum, material from the following sources has been available for the present study: Museum of Comparative Zoology (through Nathan Banks); Illinois State Natural History Survey (through S. A. Forbes and T. H. Frison); Nova Scotia Department of Agriculture (through W. H. Brittain); British Columbia Department of Agriculture (through W. Downes); State College of Iowa (through Carl J. Drake); University of Kansas (through Paul B. Lawson); and the private collections of E. D. Ball, and the author. Throughout the following pages names or abbreviations in parentheses indicate the location of the specimens recorded. The writer much appreciates the cooperation of the individuals and institutions named above.

Further acknowledgment is due J. R. Malloch, who made special efforts to collect material and donated it to the writer, and who made the drawings for Plate 1.

KEY TO THE GROUPS OF SPECIES

For the purposes of this key, the sectors (1–3), the cross veins (1–4), the apical veins (1–3), and the apical cells (1–4), are numbered in order from the costal to the radial margin of the tegmen.

1. Third apical vein continuous (or nearly so) with third sector, fourth apical cell therefore approximately triangular (fig. 10)----Group 3, p 35
— Third apical vein separated from third sector by a portion of the third cross vein, the fourth apical cell therefore distinctly trapezoidal (figs. 1–9)---- 2
2. A dark spot where cross vein 1 and each of the apical veins joins the margin of the tegmen (fig. 1); outer claspers of male distinctly shouldered (fig. 11)----Group 1, p. 5
— Without these dark spots; outer claspers of male usually gradually narrowed from base----Group 2, p. 8

GROUP 1

The species of this group examined all have the aedeagus three-branched from base, the outer clasper distinctly shouldered and definitely bristled (fig. 11), and the inner clasper with a tooth below at beginning of the apical curvature (fig. 12); the eighth sternite in the females seen is more or less emarginate laterally; besides the dark spots at intersection of apical veins and wing margins, there are dark clouds between the sectors just anterior to the cross veins.

KEY TO THE SPECIES OF GROUP 1

1. Apex of scutellum black, and a spot on middle of anterior margin of pronotum dark; length 4 mm. or more; lateral branches of aedeagus distinctly shorter than central one (fig. 15)----ulmi Linnaeus p. 5
— Lacking these dark markings; length less than 4 mm.; lateral branches of aedeagus nearly as long as, or even longer than, central one---- 2
2. Tegmina washed with greenish-yellow; central shaft of aedeagus unbranched apically (fig. 16)----tenerrima Herrich-Schaeffer, p. 6
— Tegmina whitish-hyaline; central shaft of aedeagus with apical processes-- 3
3. Aedeagus with two pairs of lateral appendages, central shaft simply bifid apically (figs. 18–19)----unca, new species, p. 8
— Aedeagus with one pair of lateral appendages, central shaft with two pairs of apical appendages (fig. 21)----piscator, new species, p. 7

TYPHLOCYBA ULMI Linnaeus

Cicada ulmi LINNAEUS, CAROLUS, Systema naturae, Regnum animale, ed. 10, 1758 (Engelmann reprint, 1894), p. 439 [Sweden?].

Cicada ulmi LINNAEUS, CAROLUS, Fauna Suecica, sistens Animalia Sueciae Regni, etc., 1761, species 900, p. 243 [Sweden].

[8] *Eupteryx ocellata* CURTIS, JOHN, British Entomology, vol. 14, 1837, art. 640 [p. 2]. [Great Britain.]

Male.—General color above pale greenish-yellow, more hyaline near costa, and fumose in apical cells; a spot, sometimes faint, on

[8] Synonymy of European forms is given on the authority of Oshanin's Verzeichnis, 1907, and have not been verified by the writer.

middle of front margin of pronotum, apex of scutellum, first cross vein and ends of apical veins black or blackish; apical cells dusky fumose, a band across tegmen in front of cross veins a little darker; below pale yellow (brighter on face), abdomen black with pale edgings, outer claspers pale yellowish.

Hypogium with the lower posterior angle of ninth segment rounded, prominent, projecting farther posteriorly than the upper; the lower side of the segment a little emarginate subapically. Outer clasper broad basally abruptly contracted about the middle, the shoulder very prominent, the narrow apical portion of about same width to the rounded apex, with definite bristling as in Figure 11; inner clasper with a prominent tooth below beginning of apical curvature, apex acute (fig. 12). Aedeagus with the central shaft, fairly stout, upcurved, tapering gradually to near apex and ending in a curved slender bifid process; two stout processes about two-thirds as long as the central shaft arise from the base of the aedeagus, the apical third of each directed outwardly, the apex moderately acute (figs. 13–15).

Female.—Like the male in color but having in addition two oval dark spots on rondure of vertex; genitalia largely dark. Eighth sternite moderately pointed medially, distinctly emarginate each side of median process and moderately lobate laterally (fig. 105); ovipositor sheaths each with a row of about eight conspicuous pale bristles.

Length, 3.5–4 mm.

Distribution.—This species occurs over most of Europe and specimens from England and Germany have been examined. American localities represented in material studied by the writer are:

Cambridge, Mass., October 24 to 30, November 1 (M. C. Z.); Vineland, Ont., August, 1922, W. Robinson; Jordan, Ont., August 15, 1916, W. A. Ross (Kans. Univ.); two miles west of St. Louis, Mo., April 25, 1904, W. V. Warner (U.S.N.M.); Vernon, B. C., September 25, 1919, on elm, W. Downes (Ball); Vernon, B. C., September 29, 1919, on elm, W. Downes (McAtee); Victoria, B. C., August 12, 1920, on elm, W. Downes (Downes, Kans. Univ.); Mount View, Calif., Ehrhorn (Ball).

TYPHLOCYBA TENERRIMA Herrich-Schaeffer

Typhlocyba tenerrima Herrich-Schaeffer, G. A. W. in the continuation of Panzer, G. W. F., Faunae Insectorum Germanicae oder Deutschlands Insecten, 124, 10a, 164, 16, 1834 [Germany]. This reference not verified.

Typhlocyba rubi Hardy, James, Descriptions of some new British Homopterous Insects, Trans. Tyneside Nat. Field Club, vol. 1 (1846–1850) 1850, pp. 417–418 [Great Britain].

Male.—General color above pale greenish-yellow, the costa glassy, the membrane fumose hyaline; faint clouds between sectors anterior to cross veins, first cross vein and ends of apical veins, dusky; underparts pale yellowish, sometimes with narrow transverse dark bands across abdomen. Hypopygium: Outer claspers of the same shape and with the same bristling as in *ulmi* (see fig. 11). Inner clasper with a distinct, slightly falcate tooth below at beginning of apical curvature, apex acute. Aedeagus with a stout central shaft and two longer, rather broad, and moderately pointed lateral appendages from the base (figs. 16–17).

Female.—Coloration as in male. Eighth sternite a little more rounded medially and less emarginate laterally than in *ulmi* (see fig. 105); bristling of ovipositor sheath the same.

Length 3–3.5 mm.

Distribution.—Has been recorded from many localities in Europe from Sweden to Italy and westward; specimens from England and France have been available for the present study and from them the description here given has been drawn. The writer has been unable to verify the reported occurrence of this species in America. Van Duzee[9] gives records for Quebec, Ontario, Maine, New Hampshire, New York, Michigan, and Colorado.

TYPHLOCYBA PISCATOR, new species

Male.—Head and thorax pale yellowish, the tegmina whitish hyaline, sometimes slightly washed with yellow; faint clouds between sectors anterior to cross veins, and distal ends of first cross vein and apical veins, dusky (fig. 1); underparts pale yellow. Hypopygium: Lower posterior angle of ninth segment well rounded off, the upper rounded prominent; outer claspers distinctly shouldered; inner clasper with a tooth below at the beginning of apical curvature, the apex very acute. Aedeagus with the long slender central shaft bent downward (just the reverse of the prevailing type in the genus) the apex aculeate; just basad of the apex are two pairs of slender, curved, pointed appendages of which the inferior are longest. From the base of the aedeagus arise two long sinuous pointed processes, three-fourths as long as the aedeagus itself (fig. 21–22).

Female.—Colored like male. Eighth sternite convex, slightly emarginate both medially and laterally.

Length, 3–3.5 mm.

Holotype.—Male, Elizabeth, Ill., July 8, 1917 (Ill. State Nat. Hist. Survey); Allotype, female, and paratype, male, Ames, Iowa, Sept. 28, 1894 (State Coll. Iowa).

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[9] Catalogue Hemiptera, 1917, p. 710.

TYPHLOCYBA UNCA, new species

Male.—Color as in *T. piscator* the tegmina somewhat more densely whitish, the clouds in front of cross veins slightly larger. Hypopygium: Upper posterior angle of ninth segment produced and moderately angulate, the lower well rounded. Claspers of the same type as in *ulmi* and *tenerrima*, the angulate shoulder on outer side of outer clasper not quite so prominent. Aedeagus stout, a superior view showing two divergent acute processes from base which are as long or a little longer than central process; the latter is again subdivided at about its middle, emitting two rami which at first are abruptly divergent, then parallel, and ultimately slightly outcurved and acute; the central shaft continues beyond them and is slightly enlarged subapically and recurved and bifid apically (figs. 18–20).

Female.—Dusky markings usually less distinct than in male. Eighth sternite slightly emarginate both laterally and medially.

Length, 3 mm.

Holotype.—Male, Mount Washington, N. H. (E. D. Ball); Allotype, female and paratypes, both sexes, Ames, Iowa, June 19, 1897 (State Coll. Iowa); Paratypes of both sexes, Salem, N. Y., June 27, 1924, on birch, E. D. Ball (Ball); and Glencarlyn, Va., June 11 to 21, 1925, J. R. Mallach (McAtee).

GROUP 2

Besides the characters mentioned in the key, it may be mentioned that the aedeagus in species of this group is seldom bifid and rarely caliper-like or trifid.

KEY TO THE SPECIES OF GROUP 2

1. Forms with distinct, though sometimes not extensive dark markings on tegmina 2
— Forms without dark markings on tegmina 13
2. Dark markings consisting only of spots near cross veins or of a band across these veins 3
— Dark markings otherwise 9
3. With dusky spots only 4
— With a band over cross veins 8
4. Males 5
— Females 7
5. Apices of inner claspers directed inwardly, often projecting between the outer claspers (figs. 40–41); aedeagus as in Figures 41–42, **flavomarginata** Gillette and Baker, p. 17
— Apices of inner claspers directed outwardly 6
6. Outer clasper with a single long bristle near base (fig. 54); ninth segment unusually long as seen from side (fig. 55), its posterior margin not sinuate; aedeagus as in Figures 56–58 ..... **gillettei** Van Duzee, p. 23.
— Outer clasper without such a bristle; ninth segment not unusually long, its upper posterior angle produced, the posterior margin sinuate; aedeagus as in Figures 77–78 ..... **antigone**, new species, p. 35

7. (Three alternatives). Eighth sternite moderately pointed apically, the apex projecting farther posteriorly than the sides (fig. 101).
gillettei Van Duzee, p. 23
— Eighth sternite with broadly rounded lateral lobes which project farther posteriorly than middle of segment, hind margin sinuate between these lobes (fig. 108)——flavomarginata Gillette and Baker, p. 17
— Eighth sternite moderately emarginate both laterally and medially.
phryne, new species, p. 34
8. Eighth sternite of female slightly emarginate medially (fig. 107); aedeagus of male without crossed processes at apex (figs. 49–50).
rubriocellata Malloch, p. 20
— Eighth sternite moderately pointed medially (fig. 107); aedeagus of male with crossed processes at apex (figs. 56–57)——gillettei Van Duzee, p. 23
9. Dark marking, including a vitta along commissure—— 10
— Dark markings otherwise—— 11
10. Scutellum or narrow margins thereof also dark——commissuralis Stal, p. 11
— Marks like parentheses on thorax, and spots anterior to crossveins also dark——phryne, new species, p. 34
11. Species from 4 to 5 mm. in length——cymba McAtee, p. 21
— Species from 3 to 4 mm. in length—— 12
12. (Three alternatives). Tegmen with a dark band across base and another across apex of corium, or wholly dark to crossveins; aedeagus as in figures 71–72 (a European species recorded from this country, but American specimens not seen by present author)——nitidula Fabricius, p. 33
— Tegmen may have similar markings, but usually with the anterior crossband near middle, not base of corium; aedeagus as in figures 56–58 (a common American species with numerous color varieties).
gillettei Van Duzee, p. 23
— Tegmen with dark dots at base, middle, and apex of clavus and dusky spots anterior to crossveins——6-notata Van Duzee, p. 34
13. Tegmina scarlet to the crossveins——tunicarubra Gillette, p. 19
— Tegmina colored otherwise—— 14
14. Females—— 15
— Males—— 21
15. (Four alternatives). Eighth sternite distinctly emarginate medially (figs. 106, 108)—— 16
— Eighth sternite almost evenly convex posteriorly, sometimes slightly emarginate medially—— 17
— Eighth sternite more or less emarginate laterally (figs. 101, 103), but scarcely to be described as pointed medially—— 19
— Eighth sternite distinctly pointed medially (fig. 104), but sometimes may appear slightly emarginate laterally——rosae Linnaeus, p. 13
ariadne, new species, p. 14
niobe, new species, p. 20
lethierryi Edwards, p. 15
16. Posterior angles of eighth sternite developed as rounded lobes (fig. 108).
flavomarginata Gillette and Baker, p. 17
— Posterior angles of eighth sternite not so developed (fig. 106).
modesta Gibson, p. 33
17. Tegmina with distinct dark crossbands——duplicata, new species, p. 16
— Tegmina without crossbands—— 18

18. Most specimens with a decidedly yellowish wash—arsinoe, new species, p. 31
persephone, new species, p. 11
xanthippe, new species, p. 14
— Rarely yellowish—commissuralis Stal, p. 11
melite, new species, p. 32
19. Species from 4 to 5 mm. in length—cymba McAtee, p. 21
— Smaller species— 20
20. Lateral emarginations of eighth sternite decided (fig. 109).
euphrante, new species, p. 12
— Lateral emarginations of eighth sternite slight (figs. 101, 103).
pomaria, new species, p. 29
gillettei Van Duzee, p. 23
21. Outer clasper with a strong outwardly and posteriorly directed bristle near outer basal angle (fig. 54) ; aedeagus as in figures 56–58.
gillettei Van Duzee, p. 23
— Outer clasper without such a bristle— 22
22. Lower posterior angle of ninth segment developed as a more or less prominent, downwardly directed, tubercle or process, which is heavily pigmented apically, and generally can be seen without disection; outer claspers usually black apically— 23
— Lower posterior angle of ninth segment not so developed; outer claspers usually not black apically— 25
23. Outer claspers heavily pigmented apically (five alternatives).
Aedeagus as in figures 68–69—melite, new species, p. 32
Aedeagus as in figure 23—persephone, new species, p. 11
Aedeagus as in figures 45–46—lancifer, new species, p. 19
Aedeagus as in figures 64–65—athene, new species, p. 31
Aedeagus as in figure 67—andromache, new species, p. 32
— Outer claspers not heavily pigmented apically— 24

24. Lower posterior angle of ninth segment developed as a long falcate, acute and heavily pigmented process (fig. 59) ; aedeagus as in figures 61–62; outer claspers not black apically—pomaria, new species, p. 29
— This process not long and falcate (three alternatives).
Aedeagus as in figure 66—arsinoe, new species, p. 31
Aedeagus as in figures 29–30—ariste, new species, p. 13
Aedeagus as in figure 47—niobe, new species, p. 20
25. Apices of inner claspers directed inwardly, usually to be seen protruding on median line between outer claspers (fig. 40) ; aedeagus as in figures 41–42—flavomarginata Gillette and Baker, p. 17
— Apices of inner claspers directed outwardly, usually visible laterally between outer claspers and ninth segment— 26
26. Species from 4 to 5 mm. in length ; aedeagus as in figures 51–52.
cymba McAtee, p. 21
— Smaller species— 27
27. One or both posterior angles of ninth segment produced posteriorly— 28
— Neither angle produced— 29
28. (Three alternatives). Lower posterior angle of ninth segment developed as a prominent posteriorly directed tooth (fig. 24) ; aedeagus as in figures 29–30—euphrante, new species, p. 12
— Upper posterior angle of ninth segment distinctly angulate produced, hind margin emarginate (fig. 35) ; aedeagus as in figure 36.
ariadne, new species, p. 14

— Side of ninth segment produced and decidedly narrowed, with a tooth at both the upper and the lower posterior angles (fig. 73); aedeagus "two-storied" (fig. 74)_____modesta Gibson, p. 33

29. (Three alternatives):

Aedeagus as in figures 31 and 33_____rosae Linnaeus, p. 13

Aedeagus as in figure 34_____xanthippe, new species, p. 14

Aedeagus as in figure 37_____lethierryi Edwards, p. 15

TYPHLOCYBA PERSEPHONE, new species

Male.—Pale yellowish above and below, the tint on tegmina to crossveins being near to light cadmium yellow, apical cells faintly fumose. Hypopygium: Ninth segment with the upper posterior angle rounded, the lower slightly produced into a moderately developed tooth which is heavily pigmented apically. Outer clasper narrowed at about middle then slightly broadened, narrowed again for the posterior fourth which is rounded, slightly spatulate, and heavily pigmented apically. Inner clasper narrowed from base, simply curved, until beginning of the distal fourth which is more abruptly curved outwardly, and aciculate apically. Aedeagus about twice as long as connective, consisting (apart from the attachments for muscles at base) of a simple shaft upwardly curved to middle, then slightly decurved, the apex again slightly upcurved, channeled along upper side and somewhat bilobate at apex (fig. 23).

Female.—Paler than male, stramineous, more or less tinged with yellow; eighth sternite evenly convex posteriorly.

Length, 3.5 mm.

Holotype, allotype, and paratypes.—Of both sexes, Ames, Iowa, June 20, 1897, E. D. Ball (Ball).

TYPHLOCYBA COMMISSURALIS Stal

Typhlocyba commissuralis STAL, C., Beitrag zur Hemipteren-Fauna Siberiens und des Russischen Nord-Amerika, Ent. Zeit. (Stettin), vol. 19, 1859, p. 196 [Sitka, Alaska].

Male.—For color characters see key to color varieties and descriptions below. Hypopygium (fig. 25): Upper angle of 9th segment well rounded off, lower rather prominent, with a slight angulation on inner side; a patch of bristles near articulation of outer clasper, and some finer hairs on posterior margin below anal tube; outer claspers narrowed gradually from base, apex rounded; inner clasper strongly upcurved apically, ending in a long, sharp thorn which projects laterally at right angles to the general vertical plane of the clasper (fig. 27); aedeagus twice as long as connective, provided apically with two pairs of slender, freely movable, lanceolate appendages of which the posterior (outer) pair are the longer (figs. 26, 28).

Female.—For color characters see key to color varieties and descriptions below. Eighth sternite evenly convex posteriorly (fig. 100); due to posture of the sternite, it sometimes appears a little pointed medially, or a little emarginate laterally, but the hind margin, as well as may be is smoothly rounded.

Length, 3.5–4 mm.

This species often has the second apical cell long-stalked, but this character is quite variable as in other species of the genus.

KEY TO THE COLOR VARIETIES OF COMMISSURALIS

1. At least the free margins of scutellum, and the commissure, dusky to black; these markings usually covering most of scutellum and the inner margins of tegmina broadly ..... var. commissuralis Stal.
Entirely lacking dark markings above ..... var. munda, new variety.

TYPHLOCYBA COMMISSURALIS, var. COMMISSURALIS Stal

The general coloration above varies from whitish to greenish yellow, and the scutellum and commissure have dark markings as noted in key. Underparts whitish to yellowish.

Records: Vancouver, B. C., C. F. Baker; Kaslo, B. C., July 17, A. N. Caudell (U.S.N.M.); Victoria, B. C., August 30, 1921, on Lombardy poplar; November 11, 1921, on alder; Penticton, B. C., September 22, 1919, W. Downes (Downes); Easton, Wash.; Lake Tahoe, Placer Co., Calif., September (U.S.N.M.); Hamilton, Calif., June 22, 1908, Colfax, Calif., June 23, 1908 (Ball); Idaho, C. F. Baker; Colorado, 2284 (U.S.N.M.); North Park, Colo., August 20, 1899 (Ball).

TYPHLOCYBA COMMISSURALIS, var. MUNDA, new variety

Like the typical variety except for entire lack of dark markings above.

Holotype.—Male, paratype male, allotype and paratype females, Vancouver, B. C., C. F. Baker (U.S.N.M.).

Paratypes: N. Westminster, B. C., September 14, 1920, W. Downes (Downes); New York, September 1, 1919; Saanich District, B. C., September 12, 1918, W. Downes (Ball).

A male too much damaged to be designated a paratype, 2 miles west St. Louis, Mo., April 25, 1904, W. V. Warner (U.S.N.M.).

Holotype, allotype, and paratypes.—Cat. No. 28488, U.S.N.M.

TYPHLOCYBA EUPHRANTE, new species

Male.—General color above pale yellow, at its deepest approaching cadmium yellow; scutellum paler; apical cells faintly fumose hyaline; underparts stramineous to pale yellow. Hypopygium: Upper posterior angle of ninth segment well rounded off, with several strong bristles, lower angle produced in a distinct posteriorly

projecting triangular process (fig. 24). Outer claspers gradually narrowed for about two-thirds of their length, then more abruptly, the apices spatulate and slightly divaricate. Inner claspers somewhat as in *T. commissuralis*, aedeagus also similar to the same organ of that species, rather more slender, however, and with the pairs of apical appendages more contrasted in length (figs. 29–30).

Female.—Coloration as in male; vertex in the single specimen at hand longer than in male and more nearly angulate than usual in the genus. Eighth sternite, very slightly emarginate medially, decidedly so laterally, sides projecting about as far posteriorly as center of hind margin (fig. 109).

Length, 3–3.5 mm.

Holotype.—Two other males, and allotype female, Soldier, Utah, August 13, 1906 (Ball).

TYPHLOCYBA ARISTE, new species

Male.—Head and thorax pale greenish yellow; tegmina hyaline, slightly washed with greenish yellow, apical cells hyaline; lower parts pale yellowish. Hypopygium: 9th segment as in *T. commissuralis* (fig. 25) except that the lower posterior angle is produced downward in a flap-like lobe. Claspers and aedeagus as in *T. euphrante* (figs. 29–30).

Length, 3.25 mm.

Holotype.—Pecos, N. M., September 1, on *Ribes*, T. D. A. Cockerell. (Ball).

TYPHLOCYBA ROSAE Linnaeus

Cicada rosae LINNAEUS, C., Systema naturae, ed. 10, 1758 (Engelmann Reprint, 1894), p. 439 [Sweden?].

Cicada rosae LINNAEUS, C., Fauna Suecica, 1761, Species 902, p. 244 [Sweden].

Typhlocyba pteridis DAHLBOM, A. G., Anteckningar öfver Insekter, som blifvit observade pa Gottland och i en del af Calmare Län, under sommaren 1850, Kgl. Vet.-Akad. Handl. (1850) 1851, pp. 179–181 [Gottland].

Typhlocyba lactea DOUGLAS, J. W., Notes on British Homoptera, with descriptions of new species, Ent. Mo. Mag., vol. 12, September, 1875, p. 77 [Great Britain].

Male.—General color stramineous, both above and below, sometimes with a yellowish wash on sectors and about front of head. The species is described by Edwards [10] as chiefly whitish, and with faint dusky spots anterior to crossveins. The latter markings have not been present on any specimen seen by the present writer. Hypopygium: Upper angle of 9th segment slightly produced in a short downwardly and inwardly projecting process, below which the posterior margin of segment is slightly emarginate (fig. 32).

[10] Homoptera British Islands, 1896, p. 216.

Ninth segment with a patch of bristles near articulation of outer claspers, the latter with several equidistant long setae within; posterior margin of segment and anal tube also with long slender hairs, the apex of latter with a few bristles also. Outer and inner claspers shaped as in *T. pomaria* (figs. 59–60). Aedeagus measured along curve only about 1½ times as long as connective, greatly dilated subapically, the tip with four lanceolate appendages of which the outer (morphologically inferior) pair are about one-fourth longer, stouter, and more curved than the inner (figs. 31–32).

Female.—Coloration as in male; eighth sternite moderately emarginate laterally and quite pointed medially as in *T. ariadne* (fig. 104).

Records: Arnold Arboretum, Boston, Mass., July 27, 1921, on rose, Harold Morrison (U.S.N.M.); Malden, Mass., June, 1895 F. H. Sprague (M. C. Z.); Ithaca, N. Y., July 1921, Paul B. Lawson (Kans. Univ.); Pittsburgh, Pa., May 25, 1894, including nymphs, on apple, J. P. Henderson (U.S.N.M.); Rocky River, Cleveland, Ohio, September 1, 1920, on Delaware grape, C. I. Bliss (McAtee); Green Bay, Wis., June 10, 1917, on rose, E. D. Ball (Ball); Urbana, Ill., October 1, 1907, November 4, 10, 1915 (Ill. State Nat. Hist. Survey); Salt Lake, Utah, June 4, 1910; Logan, Utah, June 26, 1906 (Ball); Vancouver, B. C., C. F. Baker; Wenatchee, Wash., June 26, 1914, on apple, E. J. Nelson (U.S.N.M.); Mt. View, Calif., September 21, 24, Ehrhorn; San Francisco, Calif., July 25, 1912, E. D. Ball; Quincy, Calif., July 23, 1912, E. D. Ball (Ball).

TYPHLOCYBA XANTHIPPE, new species

Male and female.—Agree with *T. lethierryi* as described in this paper, except that the posterior appendages of the aedeagus are unbranched, the anterior simply forked (fig. 34), and the eighth sternite of female almost evenly convex.

Length: 3.5–3.75 mm.

Holotype.—Male, allotype, and paratypes of both sexes New York, N. Y., June 22, 1924; paratypes and several teneral specimens; Boston, Mass., June 23, 1924, E. D. Ball (Ball).

A specimen from Lille, France, seems to be this species which therefore may have a name in Europe, but I have been unable as yet to confirm this surmise.

TYPHLOCYBA ARIADNE, new species

Male.—Pale yellowish above, apical cells more hyaline, underparts stramineous. Hypopygium: Upper angle of 9th segment produced as a strong inwardly projecting tooth, below which the hind margin of the segment is emarginate, the side below this forming a prominent obtuse lobe (fig. 35). Outer claspers gradually nar-

rowed from base, inner strongly curved outwardly near apex, then downwardly, aciculate. Aedeagus slender, with two pairs of furcate apendages at apex, of which the superior (anterior) are longer, more curved, and more deeply forked (fig. 36).

Female.—More whitish above than male, otherwise the same. Eighth sternite somewhat emarginate laterally, and quite pointed medially (fig. 104).

Length, 3.5–4 mm.

Holotype.—Male, allotype female and paratypes of both sexes, Vancouver, B. C., C. F. Baker; two paratype males, Kaslo, B. C., July 17, 1903, R. P. Currie, and a female, same locality, July 16, A. N. Caudell, U. S. N. M.; paratype female, Royal Oak, B. C., September 29, 1917, W. Downes (Downes).

Holotype, allotype and paratype.—Cat. No. 28489, U.S.N.M.

This species seems to be allied to *T. bergmani* Tullgren,[11] but probably is distinct. In that species the posterior (morphologically inferior) appendages are the longer pair; in coloration *T bergmani* differs by having two dark spots on scutellum.

A specimen labelled only California (State Coll. Iowa) and somewhat damaged, is not made a paratype.

TYPHLOCYBA LETHIERRYI Edwards

Typhlocyba lethierryi EDWARDS, JAMES, An additional species of British Homoptera, Ent. Mo. Mag., vol. 17, p. 224, March, 1881 [England].

Male.—Varies in color from stramineous as to head and thorax, and whitish hyaline as to tegmina, to sulphur or even orange yellow above, as far posteriorly as the crossveins, apical cells in that case hyaline though the tegminal margin and apical veins may be colored. In highly colored specimens, according to Edwards, the head, pronotum, and commissure may be more or less tinged with reddish. Hypopygium: Lower posterior angle rather squarish, somewhat incurved, upper with a slight emargination, above which is a short inwardly projecting tubercle. The patch of bristles near articulation of outer clasper is conspicuous. Outer clasper with a strong outwardly directed bristle near base as in *T. gillettei* (fig. 54), tapering more gradually than abruptly, the inner margin almost straight, the apex slightly spatulate; inner clasper with the terminal fourth rather abruptly outwardly directed, as in *T. commissuralis* (fig. 27). Aedeagus with a slender, upcurved shaft, surmounted at the apex by two pairs of curved and bifurcate appendages, the anterior pair on a short common stalk projecting anteriorly from the top of the central shaft (fig. 37). These figures are from a specimen collected at Colesborne, England, by J. Ed-

[11] Ent. Tidskr., vol. 37, Heft. 2, 1916, pp. 67–69 [Norway].

wards, the describer of the species, and differ from figures and descriptions published [12] by him in showing a short branch on the inner ramus of each of the anterior appendages. Probably this is merely an exuberant development in this already elaborate aedeagus that is not present to the same degree in all specimens. A specimen from Cambridge, Mass., agrees entirely in genital characters with the diagnosis of Edwards and the aedeagus is as illustrated in figure 37 except for lack of the small supplemental tooth here discussed.

Female.—Coloration like that of ordinary males, those examined being pale sulphur yellow above, with the apical cells more hyaline, and stramineous below. Eighth sternite slightly emarginate laterally, moderately pointed apically.

Length, 3.5–4 mm.

Distribution.—The species has been recorded from nearly all parts of Europe, from northern Africa, and from Michigan, Iowa, Maine, New York, and Pennsylvania. So far as the writer is aware these American records are not based on examination of the genitalia, and as we have several other species with similar coloration, there is chance for confusion. The only definite identification from the material examined by the present writer is a male collected at Cambridge, Mass., September 13 (M. C. Z.). With it are associated four females collected at the same locality October 20, 24, and November 1.

Even the European distribution of *T. lethierryi* is not a matter of certainty as specimens under that name from Lille, France, which agree in coloration have the oedeagus notably different in form, as described and figured (fig. 34) for *T. xanthippe*, new species, p. 14.

TYPHLOCYBA DUPLICATA, new species

Male.—Ground color milky-white, a little inclined to ivory on vertex and scutellum; apical cells fumose, a dusky band over crossveins, and another from middle of clavus to middle of costal plaque; under parts whitish. Hypopygium: Upper posterior angle of ninth segment produced in a broad process which is emarginate as seen from the side, and bears two acute incurved teeth which can be seen from above (much as in *T. danae*, fig. 83); lower posterior angle rounded. A conspicuous patch of bristles near articulation of outer clasper. Outer clasper, lacking single strong basal bristle as in *T. gillettei*, gradually narrowed from base for three-fourths of its length where the shoulder is so prominent as almost to suggest a process (fig. 39), apical fourth in line with the inner side of clasper, upcurved, gradually narrowed and rounded at tip. Inner

[12] Ent. Mo. Mag., March, 1908, pp. 83–84, figs. 10–11.

claspers stout at base, approximate medianly, very abruptly curved, the acute apices directed outwardly, and a little backwardly. Connective very broad at base, almost equilaterally triangular. Aedeagus but little longer than connective, bifid, the rami stout at base, gradually tapering, up- and in-curved the apices acute (fig. 38).

Female.—Colored like male. Eighth sternite emarginate laterally, the median lobe shorter and less pointed than in *T. gillettei* and itself slightly emarginate.

Length, 3.5 mm.

Holotype.—Male, allotype and paratype, females, Toronto, Ont., August 8, 1924, some of them labeled *Crataegus*, E. D. Ball (Ball).

The color pattern of this species is almost exactly that of *T. gillettei*, var. *casta;* however, the ground color is decidedly milky white, which it rarely is in that variety, and the genitalia of both male and female are distinct.

TYPHLOCYBA FLAVOMARGINATA Gillette and Baker

Typhlocyba flavomarginata GILLETTE, C. P., and CARL F. BAKER, A preliminary list of the Hemiptera of Colorado, Bull. 31 (Tech. Ser. 1) Colo. Agr. Exp. Sta., June 7, 1895, pp. 111–112, 4 figs. [Manitou, Colo.].

Male.—For color characters see key to color varieties and descriptions farther on. Hypopygium (fig. 40): Upper posterior angle of ninth segment moderately produced in a rather rounded incurved angle that is not so obvious from the side as from a dorsal or inside view of the segment, lower angle receding and rounded. Outer claspers as seen from below gradually narrowed from base; on the outer side is a thin vertical crescentic plate extending from near base to apex of clasper. The inner claspers (fig. 41D) are fairly stout at base, much narrowed and approximate at about their middle length, then divergent with a more or less prominent tooth on outer side at beginning of posterior fourth, where the clasper is abruptly bent *inwardly* and downwardly, the apex aciculate. (This clasper differs from that of all the other American species seen in the apex, being directed inwardly instead of outwardly. The claspers of *T. gratiosa* Boheman are similar but the aedeagus is different.) Aedeagus short and stout at base, hardly longer than connective, divided just distad of middle into two strongly divergent rami which are inflated at base, and abruptly tapered at about the middle into inwardly and downwardly directed slender aciculate processes (figs. 41–42).

Female.—For color characters see key to color varieties and descriptions farther on. Eighth sternite with the posterior angles developed as prominent rounded lobes, a broad rounded emargination between them, the center of which is slightly notched (fig. 108).

Length, 3.5–4 mm.

KEY TO COLOR VARIETIES OF FLAVOMARGINATA

1. Tegmen lacking reddish coloration 2
   Tegmen with more or less reddish coloration 3
2. Tegmen of female whitish hyaline without flavescent margins
   var. vesta, new variety.
   Tegmen of female whitish hyaline, flavescent on margins anterior to crossveins; of male wholly flavescent, deeper on margins
   var. flavomarginata Gillette and Baker.
3. Clavus mostly orange-red ..... var. media, new variety.
   Whole tegmen except apical cells washed with wine red, deepest on clavus
   var. scorta, new variety.

TYPHLOCYBA FLAVOMARGINATA, var. VESTA, new variety

Head, thorax, and underparts stramineous, tegmina whitish-hyaline, eyes, claws, and tip of ovipositor black, apical cells faintly fumose.

Holotype and paratype.—Females, Salt Lake City, Utah, July 13, 1908; another paratype female, same locality, August 29, 1908 (E. D. Ball).

TYPHLOCYBA FLAVOMARGINATA, var. FLAVOMARGINATA Gillette and Baker

Male.—Head and thorax pale yellow, tegmina entirely flavescent.

Female.—Head, thorax, and underparts pale yellow, claws and tip of ovipositor black, eyes greenish; tegmina whitish hyaline, the commissure distinctly and the costa less distinctly flavous margined, apical cells fumose.

Three females from the Gillette and Baker collections, undoubtedly the type material are labelled "Colo." only. A male with same data is labelled cotype, but it can have no such standing as the species was described from females only. This specimen is now designated as neo-allotype. (U.S.N.M.) Other specimens seen are labelled, Alder, Colo., August 25, 1899, Durango, Colo., August 7, 1899, and Salida, Colo., October 8, 1898 (E. D. Ball); Colorado Springs, Colo., 5915 feet, July; Garden of the God, Colo., July, E. S. Tucker (Kans. Univ.); Pecos, N. Mex., September 1, on oak, T. D. A. Cockerell (Ball).

Holotype and paratypes.—Cat. No. 3456, U.S.N.M.

TYPHLOCYBA FLAVOMARGINATA, var. MEDIA, new variety

Male.—General color pale yellow, a little richer flavous on costa and patches elsewhere on tegmen; apical cells fumose, and spaces between sectors anterior to crossveins with dusky spots, the inner most pronounced. Large triangle on pronotum, basal triangles of scutellum, and clavus chiefly orange-red.

Female.—Similar to male but with less yellow on tegmen and less red markings on pronotum and scutellum. Underparts pale yellowish except for the dark claws and tip of ovipositor.

Holotype.—Male and allotype female, Colorado Springs, Colo.; July 19, 1901; paratype female, Trindad, Colo., July 13, 1899 (E. D. Ball).

TYPHLOCYBA FLAVOMARGINATA, var. SCORTA, new variety

Male.—General color pale yellow; tegmen anterior to crossveins washed with pinkish or vinaceous red, the costa and apical cells flavescent.

Female.—Similar to male, the tegmina without yelowish coloration and more exclusively covered with the reddish tinge; apical cells nearly hyaline.

Holotype.—Male and allotype female, Altus, Utah, July 30, 1911; paratype male and female Salt Lake City, Utah, July 13, 1908 (E. D. Ball).

TYPHLOCYBA TUNICARUBRA Gillette

Typhlocyba tunicarubra GILLETTE, C. P., American Typhlocybinae, Proc. U. S. Nat. Mus., vol. 20, 1898, pp. 752–753 [Mich. Agr. College.]

Male.—Head and thorax yellow, the scutellum somewhat dusky posteriorly; tegmina from all but extreme base nearly to crossveins scarlet when fully colored, apical cells yellowish hyaline the veins deeper yellow; face yellow, other underparts whitish. Hypopygium: with the side of 9th segment widened apically, both the upper and lower angles squarish, prominent. Outer claspers, turgid prominent at bend, the upcurved terminal third much narowed, rounded apically; inner claspers of the simply curved type, the apices directed outwardly, and acute. Aedeagus somewhat longer than connective, the basal two-thirds a simple shaft (as seen from above) which expands distally, and is bified into two laterally and upwardly directed, inflated, rami; from the inner side of apex of each arises an inwardly, downwardly and posteriorly directed acuminate process, which crosses its fellow near apex (fig. 43–44).

Female.—Coloration as in male; eighth sternite long, evenly convex posteriorly; apparent slight emargination medialy in some specimens probably caused by pressure of ovipositor.

Length, 3.6–4 mm.

Records: Conesus Lake, N. Y., July 16, 1916, H. H. Knight (Ball, Kans. Univ.); Holotype, female, Agr. College, Mich., July 15, 1891 (U.S.N.M.); Lake Geneva, Wis., July 21, 1918, on bur oak; Ames, Iowa, July 26, 1919, E. D. Ball (Ball); Douglas County, Kans., August, 1923, W. Robinson (Kans. Univ.).

Holotype.—Cat. No. 3442, U.S.N.M.

TYPHLOCYBA LANCIFER, new species

Male.—Head and thorax pale yellow, tegmina to crossveins cadmium to light orange yellow; apical cells whitish hyaline; under-

parts stramineous. Hypopygium: Upper posterior angle of ninth segment rounded, the lower produced as a short blunt tooth, the apex of which as well as that of the outer clasper is heavily pigmented; outer clasper narrowed from base, a little bowed outwardly at two-thirds of its length, then narrowed and again slightly turned outward at the apex which is broadly rounded; inner claspers approximate medially, in general curved outwardly the apical fourths rather abruptly so; aedeagus thrice as long as connective, the slender upwardly directed shaft bifid on the apical third into processes which are lanceolately expanded apically (figs. 45–46).

Length 3–3.5 mm.

Holotype and paratype.—Males, Hampshire County, Mass., June, 1922, Philip A. Readio (Kans. Univ.); paratype male, Urbana, Ill., June 4, 1916 (Ill. State Nat. Hist. Survey).

TYPHLOCYBA NIOBE, new species

Male.—Head and thorax pale greenish yellow, tegmina to crossveins deeper yellow, apical cells hyaline; underparts stramineous. Hypopygium: Upper posterior angle of ninth segment rounded, lower produced downwardly in a short, blunt, black-tipped tooth. Outer and inner claspers as in *T. persephone.* Aedeagus more than twice as long as connective, bifid almost from base, the rami upwardly directed and parallel for three-fourths of their length, then diverging outwardly and curving a little posteriorly, apices acute (fig. 47).

Female.—Paler than male; eighth sternite rather pronouncedly emarginate laterally and pointed medially.

Length 3.25–3.75 mm.

Holotype.—Male, Racine, Wis., July 30, 1916, J. G. Sanders (Ball); allotype, and paratypes, Iowa, No. 2803 (State Coll. Iowa); paratypes of both sexes, Ames, Iowa, June 23, on hard maple, E. D. Ball (Ball).

Except for paler coloration this species agrees with the description of *Empoa aureotecta* Sanders and De Long[13]. However, only females of that form are known as yet, so the question of its exact identity can be solved only by further collection and study.

TYPHLOCYBA RUBRIOCELLATA Malloch

Typhlocyba rubriocellata Malloch, J. R., A new species of Typhlocyba from Illinois (Hemiptera, Homoptera), Bull. Brooklyn Ent. Soc., vol. 15, nos. 2–3, April-June, 1920, p. 48 [Augerville Grove, Urbana, Ill.]

Male.—Head and thorax yellowish-white, washed with greenish-yellow; tegmina whitish-hyaline, corium near base washed with

[13] Ann. Ent. Soc. Amer., vol. 10, No. 1, March, 1917, pp. 93–94 [Madison, Wis.].

pinkish-red, which color extends along costa and sectors fading posteriorly to yellow; a broad dusky band over crossveins, apical cells fumose, 2 and 3 the least so. Underparts pale yellowish. Hypopygium: Lower posterior angle of ninth segment with a short, stout, downwardly projecting, heavily pigmented tooth, upper angle squarish (fig. 48). There is a patch of stout bristles near articulation of outer clasper, and the middle of the side of this segment has numerous pointed bristles; outer clasper and anal tube with the usual ciliation. Outer clasper narrowed from base and spatulate apically whether viewed from the side or from below; inner clasper stout and hairy at base, tapering to about two-thirds of its length, dilated and with a compound curve subapically, the apex sharp and turned outward. Apices of both claspers heavily pigmented (fig. 48). Aedeagus split from base, the parallel parts slender, expanded subapically and pointed apically; the paired hooks at base shown in figures are not connected to aedeagus by heavy chitin but appear nevertheless to be functional appendages of that organ (figs. 49–59).

Female.—General color pale yellowish white, the sectors of tegmen near crossveins touched with deeper yellow, the dusky band over crossveins as in male. Near base of each tegmen is an elongate irregular bright red spot, lying partly on clavus and partly on corium but touching neither the base, costa or commissure and extending posteriorly to or beyond middle of tegmen. Underparts pale yellowish-white, ovipositor brown, apex of sheath black. Eighth sternite about evenly convex posteriorly in general outline; distinctly angularly emarginate medially.

Length, 3.5–4 mm.

One male and several females, Urbana, Ill., July 12, 1920, J. R. Malloch (Ill. State Nat. Hist. Survey). These specimens labelled "Cottonwoods;" this term does not refer to a food plant but is an abbreviation for Cottonwood Grove, a locality name, which moreover is the same as Augerville Grove. The specimens examined, therefore, are topotypic. Mr. Malloch informs me these specimens were all collected on buckeye (*Aesculus*).

A variety without trace of the reddish spot on tegmen, but otherwise typical, represented by a female with the same data as the other specimens examined, may be known as var. *clara*, new variety.

TYPHLOCYBA CYMBA McAtee

Typhlocyba cymba McATEE, W. L., Notes on Nova Scotian Empterygid Leaf hoppers including descriptions of new species. Can. Ent., vol. 50, no. 11, Nov. 1918, pp. 360-361 [Halifax, N. S.]

Male.—For color characters see key to color varieties and descriptions further on. Hypopygium (fig. 53): Upper posterior angle of

9th segment prominent, subangulate, the apex with numerous hairs; lower angle well rounded off, receding. Outer clasper narrowed from base, but more abruptly so in posterior fourth, with a row of widely-spaced short hairs on upper margin on this portion, apex subacute; inner clasper slender, the terminal fourth curved outwardly then anteriorly and at the extreme tip, downwardly, apex aciculate (fig. 51). Aedeagus divided for its apical third into four pointed processes, of which the inner pair are shorter and converge apically, the outer longer, divergent, and curved slightly forward apically (figs. 51–52). Supporting laminae somewhat as in *T. querci.*

Female.—Eighth sternite moderately pointed medially, slightly emarginate laterally, and except for larger size, almost exactly as in *T. gillettei* (fig. 102).

Length, 4–4.5 mm.

KEY TO COLOR VARIETIES OF CYMBA

1. Pale yellowish, entirely lacking dark markings above; apex of ovipositor sheath dark ..... var. **pallens**, new variety.
— On the same general color some dark markings superimposed 2
2. Only the scutellum dark ..... var. **unipuncta**, new variety.
— Dark markings more extensive 3
3. Scutellum and a narrow band just behind middle of clavus dark ..... var. **cymba** McAtee.
— Scutellum and a dorsal saddle involving practically all of clavus, and much of the adjacent corium dark ..... var. **grata** McAtee.

TYPHLOCYBA CYMBA, var. CYMBA McAtee

Head and thorax pale yellow, flecked with pellucid greenish yellow; tegmina whitish hyaline faintly washed with greenish yellow, apical cells clear. Scutellum and a straight-sided crossband just behind middle of and confined to clavi, dusky. Underparts yellowish-white.

Halifax, Nova Scotia, August 9, 1919 (Nova Scotia Dept. Agr., and McAtee); Digby County, Nova Scotia, August 31, 1918 (N. S. Dept. Agr.); Hazelhurst, Wis., July 12, 1918, on *Acer*, L. G. Gentner (Ball).

TYPHLOCYBA CYMBA, var. PALLENS, new variety

Like var. *cymba* but entirely lacking dark markings.

Holotype.—Male, allotype, and paratype females, Halifax, Nova Scotia, August 8, 1919 (N. S. Dept. Agr., and McAtee); also Ithaca, N. Y., July 15, 1907 (Ill. State Nat. Hist. Survey); Agricultural College, Michigan, June 1, 1920, seriously injuring sugar maple: Hazelhurst, Wis., July 12, 1918, on *Acer*, L. G. Gentner (Ball).

TYPHLOCYBA CYMBA, var. UNIPUNCTA, new variety

Typhlocyba cymba, var. *unipuncta* Brittain ms.[14]

Like var. *pallens* but with the scutellum dusky, a median vitta most pronouncedly so.

Holotype.—Female, Halifax, Nova Scotia, August 9, 1919 (N. S. Dept. Agr.); Paratypes: Muskoka, Ont., July 1888, E. P. Van Duzee (State Coll. Iowa); Agricultural College, Michigan, June 1, 1920, seriously injuring sugar maple (Ball).

TYPHLOCYBA CYMBA, var. GRATA McAtee

Typhlocyba querci, var. *grata* McAtee, W. L., Report on a Second Collection of Nova Scotian Empterygid Leaf-hoppers, including descriptions of new varieties, Can. Ent. vol. 51, no. 10, October 1919, p. 226 (Digby County, N. S.).

Like the typical variety, but dark markings more extensive: Scutellum and a large saddle spot on tegmina occupying most of the clavi and a portion of each adjoining corium, dusky.

Holotype.—Female, Digby County, Nova Scotia, August 14, 1918 (N. S. Dept. Agr.). The writer is greatly indebted to Dr. W. H. Brittain for returning the type specimen to him for re-examination. It is clearly a variety of *cymba* rather than of *gillettei* (*querci*) under which it was originally described. Robust females of gillettei may closely resemble corresponding varieties of *cymba* but in practically all cases have dark markings over crossveins or in apical cells: apparently *cymba* never has such markings.

Other records: Halifax, Nova Scotia, August 9, 1919 (N. S. Dept. Agr.); Mount Washington, N. H. (Ball); Cambridge, Mass., August 19, N. Banks (M. C. Z.); Cranberry Lake, N. Y., August 9, 1920, Osborn and Drake (Ball); Rock City, N. Y., July 4, 1915, Ithaca, N. Y., July 26, 1916, H. H. Knight (Kans. Univ.); Muskoka, Ont., July 1888, E. P. Van Duzee (State Coll. Iowa); Agricultural College, Mich., June 1, 1920, seriously injuring sugar maple; Hazelhurst, Wis., July 12, 1918, on *Acer*, L. G. Gentner (Ball).

TYPHLOCYBA GILLETTEI Van Duzee

Typlocyba bifasciata Gillette and Baker, Bull. 31 (Tech. Ser. 1) Colo. Agr. Exp. Sta., 1895, p. 11, 2 figs. [Minturn, Colo.].

Typhlocyba querci, var. *bifasciata* Gillette, C. P., American leaf-hoppers of the subfamily Typhlocybinae, Proc. U. S. Nat. Mus., vol. 20, 1898, p. 766.

Empoa querci, var. *gillettei* Van Duzee, E. P., Catalogue of the Hemiptera of America north of Mexico, Univ. Calif. Publ., Tech. Bull. Ent., vol. 2, 1917, p. 708. The combination *Typlocyba bifasciata* is preoccupied by Boheman, 1852.

[14] So published with the approval of Dr. W. H. Brittain.

The name given above must take the place of the time-honored *querci* Fitch, unless we arbitrarily fix the latter upon one of the six or more species to which the brief original description applies. Dr. E. P. Felt informs me that No. 828 of Fitch, the type of *Empoa querci* is lost, hence there is no possibility of really identifying Fitch's species. Under the circumstances it seems best to drop *Empoa querci* Fitch [15] as unidentifiable, action that will also cure the more or less undesirable situation of there being in the same genus specific names so similar as *querci* and *quercus* (the latter the genotype).

Male.—For color characters see key to color varieties and descriptions farther on. Venation of tegmen as in Figures 2–9. Hypopygium: Outer claspers narrowed from base, apical third upcurved, apices rounded, a little divaricate; each clasper with a strong, outwardly and posteriorly directed pale bristle arising near outer basal angle (fig. 54). Ninth segment rather longer (as viewed from side) than in other species, the upper posterior angle rounded prominent, the lower receding (fig. 55). Inner claspers nearly semicircular in shape, the two tangent ventrally, each tapering gradually to a sharp point, the terminal fourth curved outward, then forward, then downward (fig. 56). Aedeagus with three pairs of appendages at the tip of which the inner pair are long pointed, bent at about a right angle at the middle so that they cross each other, the intermediate pair short and pointed, and the outer pair, long, slender, aciculate and divergent. Seen from the side all of these appendages have an anterior inclination or curvature, and the aedeagus is reinforced by a median and two lateral thin lamellae, the former with a hooked process apparently for muscle attachment (figs. 56–58).

Female.—For color characters see key to color varieties and descriptions farther on. Eighth sternite moderately pointed medially, slightly emarginate laterally (fig. 101). Side view of hypopygium as in figure 110.

Length, 3.5–4 mm.

KEY TO COLOR VARIETIES OF GILLETTEI

1. With no dark markings above_____sincera, new variety, p. 25
— With dark markings above_____ 2
2. Dark markings consisting of only a few dusky spots anterior to crossveins (figs. 2–3); first and second apical cells faintly fumose
fitchii, new variety, p. 25
— Dark markings both sides of the crossveins; apical cells usually more distinctly and extensively darkened_____ 3

[15] *Empoa querci* Fitch, Asa, Catalogue with references and descriptions of the insects collected and arranged for the State Cabinet of Natural History, Fourth Ann. Rept. Regents Univ. State of N. Y., 1851, p. 63, Reprint, Ninth Rep. Ins. N. Y. Lintner, 1893, p. 403 [New York].

3. Tegmina with a single more or less band-like dark marking over crossveins (figs. 4–5) ---- 4
— Tegmina with two transverse bands, or more extensive markings ---- 5
4. (Three alternatives)
Tegmina anterior to crossveins whitish or stramineous
apicata, new variety, p. 25
— Tegmina anterior to crossveins cadmium yellow
saffrana, new variety, p. 26
— Tegmina anterior to crossveins rufous ---- russeola, new variety, p. 26
5. With a dark band over crossveins and another across middle of tegmina (figs. 6–9) ---- 6
— With tegmina more extensively darkened ---- 8
6. Anterior crossband narrow, directed toward posterior end of costal plaque ---- 7
— Anterior crossband broad, passing anterior end of costal plaque
volans McAtee, p. 28
7. Scutellum pale ---- casta, new variety, p. 26
— Scutellum dark ---- gillettei, Van Duzee, p. 27
8. Scutellum, longitudinal vittæ over clavus and adjacent corium, and crossbands as in var. *gillettei*, dark ---- scripta McAtee, p. 28
— Coloration otherwise ---- 9
9. Anterior half of tegmina, band over crossveins, and scutellum dark
venusta, new variety, p. 29
— More of tegmina dark ---- 10
10. Tegmina dusky from crossveins anteriorly ---- sellata, new variety, p. 29
— Whole upper surface, except the yellowish to reddish costa, fumose to dusky ---- vestita, new variety, p. 29

TYPHLOCYBA GILLETTEI, var. SINCERA, new variety

Entirely pale yellowish white above, and also below except for the claws and tip of ovipositor.

Holotype and paratype.—Females, Buffalo, N. Y., September 1886, E. P. Van Duzee (Iowa State College.)

TYPHLOCYBA GILLETTEI, var. FITCHII, new variety

Pale yellowish white the only dark markings above being a series of three to five dusky black spots just anterior to crossveins (figs. 2–3), and the fumosity of the apical cells, generally noticeable only in cells 1 and 2.

Holotype male, Washington, D. C., July 16, 1885; Allotype, female, Washington, D. C. (U.S.N.M.); Paratypes: Washington, D. C., June 16, 1915, on *Quercus macrocarpa*, W. L. McAtee (McAtee); Buffalo, N. Y., September 1886, E. P. Van Duzee (State Coll. Iowa).

Holotype and allotype.—Cat. No. 28490, U.S.N.M.

TYPHLOCYBA GILLETTEI, var. APICATA, new variety

Ground color pale yellowish white, as usual, the only dark marking above being rather definite band over crossveins (figs. 4–5); apical cells more or less fumose. Some specimens with slight traces of a median crossband also are conveniently grouped here.

Holotype.—Male, Washington, D. C., May 28, 1902, O. Heidemann; Paratypes: Forest Glen, Md., October, 1914, O. Heidemann (U.S.N.M.); Beltsville, Md., June 23, 1918, on *Quercus alba*, W. L. McAtee (McAtee); Glencarlyn, Va., June 7, 16, 23, 1925, J. R. Malloch (McAtee); Urbana, Ill., June 7, 9, 17, 1916; White Heath, Ill., June 24, 1916, on oak; Elizabeth, Ill., July 7, 1917 (Ill. State Nat. Hist. Survey); Spirit Lake, Iowa, June 28, 1897, Ames, Iowa, June 28, 1892 (State Coll., Iowa); Spirit Lake, Iowa, June 28, 1897; Ames Iowa, June 16, 1919; Ames, Iowa, June 19, 1897, June 28, 1892, Sept. 11, 1919 (Ball).

Specimens not in good enough condition to be made paratypes: Tazewell, Va., June 10, 1915, L. O. Jackson (McAtee).

Specimens with traces of anterior crossband: Osceola, Wis., July 21, 1917; Toronto, Ont., August 8, 1924, E. D. Ball (Ball); Douglas County, Kans., June 2, 1922, P. B. Lawson (Kans. Univ.).

Holotype and paratypes.—Cat. No. 28491, U.S.N.M.

TYPHLOCYBA GILLETTEI, var. SAFFRANA, new variety

With a single dark crossband over crossveins bordered anteriorly by a hyaline area, and with the upper parts generally washed with yellow, deepest on tegmina anterior to crossveins, and varying from lemon to cadmium yellow; underparts pale yellowish-white.

Holotype.—Male, Mount Washington, N. H. (E. D. Ball); allotype, female, Douglas Co., Kans., August, 1923, W. Robinson (Kansas Univ.); paratype female, White Heath, Ill., July 5, 1916 (Ill. State Nat. Hist. Survey); paratype females, Glencarlyn, Va., June 12, 23, 1925, J. R. Malloch (McAtee).

Empoa aureotecta Sanders and DeLong [16] seems similar, but apparently is not a variety of *T. gillettei*, as it has no dark markings over crossveins. See also remarks under *T. niobe*, new species, p. 20.

TYPHLOCYBA GILLETTEI, var. RUSSEOLA, new variety

Head and thorax washed with lemon yellow, tegmina to crossveins rufous, dusky spots near crossveins in small hyaline areas; apical cells distinctly fumose; underparts pale yellowish-white, except the dark claws, and tip of ovipositor.

Holotype.—Female, Osceola, Wis., July 20, 1917, E. D. Ball (Ball).

TYPHLOCYBA GILLETTEI, var. CASTA, new variety

General color whitish to pale yellowish, apical cells dusky, a distinct dark band over crossveins, and another across tegmen at middle of clavus, scutellum pale.

[16] Ann. Ent. Soc. Amer., vol. 10, No. 1, March, 1917, pp. 93–94, figs. 43–45.

Holotype.—Male, allotype female, and paratypes, Beltsville, Md., June 23, 1918, on *Quercus alba*, W. L. McAtee (McAtee); Paratypes: Andover, Mass., Uhler Collection (U.S.N.M.); Toronto, Ont., August 8, 1924, E. D. Ball (Ball); Sea Cliff, N. Y., August, N. Banks, (M. C. Z.); Batavia, N. Y., August 12, 1916, H. H. Knight (Kans. Univ.); Glencarlyn, Va., June 16, 23, 1925, J. R. Malloch (McAtee); Cabin John Bridge, Md., July 7, 1902 (U.S.N.M.); Maywood, Va., August, 14, 1917, July 14, 1925, at light, W. L. McAtee (McAtee); Lapeer, Mich., August, 24, 1919; Madison, Wis., July 29, 1917; Osceola, Wis., July 20, 1917; Lake Geneva, Wis., July 21, 1918, on bur oak, E. D. Ball (Ball); Urbana, Ill., July 2, 1920 (McAtee); Illinois, No. 18739; Algonquin, Ill., June 10, 1896, October 13, 1895; White Heath, Ill., June 24, 1916, on oak, July 5, 1916; Urbana, Ill., June 9, 1916, July 9, 13, 14, 1920, October 25, 1916; Crystal Lake, Ill., July 21, 1916; Monticello, Ill., June 28, 1914; Elizabeth, Ill., July 6, 1917 (Ill. State Nat. Hist. Survey); Spirit Lake Iowa, August 1, 1919, on bur oak; Spirit Lake, Iowa, June 28, 1897; Iowa, July 31, 1919; Ames, Iowa, June 20, 1897, September 11, 1919 (Ball); Leavenworth County, Kans., June 30, 1924; Wyandotte County, Kans., June 21, 1924; Atchison County, Kans., July 10, 1924, R. H. Beamer; Douglas County, Kans., June 2, 1922, June 21, July 9, 1924, P. B. Lawson, August, 1923, W. Robinson (Kans. Univ.).

Paratypes.—Cat. No. 28492, U.S.N.M.

TYPHLOCYBA GILLETTEI, var. GILLETTEI Van Duzee

General color whitish to rather decidedly yellowish, with dark markings similar to those of the preceding form but usually more decided, and the scutellum dusky to black. Figures 6–9 illustrate variations in tegminal markings of specimens assigned to this variety.

Records: Digby County, Nova Scotia, August 8, 1918; Halifax, Nova Scotia, August 9, 1919 (N. S. Dept. Agr.); Mount Washington, N. H. (Ball, U.S.N.M.); Waterville, N. H., July 17, 1906; Glen to Halfway House, White Mountains, N. H., July 8, 1891 (U.S.N.M.); Boston, Mass., August 31, 1919, E. D. Ball (Ball); Cambridge, Mass., October 25 (M.C.Z.); Peabody, Mass. Andover Mass. Uhler Coll.; Connecticut (U.S.N.M.); Elba Park N. Y. August 13–18, 1917, C. J. Drake (McAtee); Albany, N. Y., June 20, 1890 (Kans. Univ.); Slide Mountains, Catskills, N. Y., September 1, E. L. Dickerson; Batavia, N. Y., August 12, 1916, on bur oak, H. H. Knight (Ball); Buffalo, N. Y., July, 1886, E. P. Van Duzee; Botanic Garden, New York, N. Y., July 7, on *Quercus macrocarpa*, H. L. Sanford; District of Columbia, May 20, 1886, June 20, 1888; Washington, D. C., July 11, 1902, July 2, 1901; Rock Creek, D. C., July 17, 1902 (U.S.N.M.); Washington, D. C., June 7, N. Banks (M.C.Z.);

Washington, D. C., June 6, 1912, June 15, July 31, 1925, W. L. McAtee; July 24, 1924, at light, J. R. Malloch; Maryland near Plummer Island, July 26, 1914, W. L. McAtee (McAtee); Virginia opposite Washington, D. C., June 15, 1902 (U.S.N.M.); Toronto, Ont., August 8, 1924, one labelled Crataegus, E. D. Ball (Ball); Cedar Lake, Ind., July 17, 1914 (Ill. State Nat. Hist. Survey); Oxford, Ind., August, 1916, Mrs. W. L. McAtee (McAtee); Madison, Wis., October 1, 1917, H. K. Harley; Reedsburg, Wis., September 27, 1917, E. D. Ball; Osceola, Wis., July 20, 1917, E. D. Ball (Ball); Waukegan, Ill., August 24, 1917 Elizabeth, Ill., July 7, 1917; Urbana, Ill., July 14, 1920 (Ill State Nat. Hist. Survey); Kings Bluff, Winona County, Minn., June 30, 1922, Paul B. Lawson (Kans. Univ.); Spirit Lake, Iowa, June 28, 1897; Ames, Iowa, June 19, 1897, on maple, July 20, 1895 (Ball); June 9, 1897 (State Coll. Iowa); Nebraska; Riley County, Kans., May, C. F. Marlatt (U.S.N.M.); Wyandotte County, Kans., June 21, 1924, R. H. Reamer (Kans. Univ.); Colorado, 2248, part of type material of *bifasciata* Gillette and Baker (Cat. No. 3454 U.S.N.M.); Fort Collins, Colo., July 11, 1900; Rist Canyon, Colo., August 20, 1898; Rico, Colo., August 2, 1900; Dutch George, Colo. August 14, 1899 (Ball).

TYPHLOCYBA GILLETTEI, var. VOLANS McAtee

Typhlocyba querci, var. *volans* McAtee, W. L., Can. Ent., vol. 51, No. 10, October, 1919, pp. 225–226 [Digby County, Nova Scotia].

With two dusky crossbands much broader than in var. *gillettei*, the posterior over the crossveins, the anterior over middle of clavi, sloping forward on the corium parallel to anterior edge of tegmen. Scutellum with two faint dusky spots in the basal triangles, apical cells fumose.

Holotype.—Female, Digby County, Nova Scotia, August 8, 1918 [N. S. Dept. Agr.].

TYPHLOCYBA GILLETTEI, var. SCRIPTA McAtee

Typhlocyba querci, var. *scripta* McAtee, W. L., Can. Ent., vol. 51, No. 10, October 1919, p. 226 [Digby County, Nova Scotia].

Scutellum chiefly dusky, tegmina with dusky crossbands at middle and on crossveins as in var. *gillettei*, and with a longitudinal dusky stripe on clavus and adjacent corium extending from near base of clavus to crossveins; apical cells smoky. These markings leave the apex of clavus, its inner margin anteriorly, narrow anterior margin or corium, and broad costal area, of the ground color (except for crossband at posterior part of costal plaque).

Holotype.—Female, Digby County, Nova Scotia, September 5, 1918 (N. S. Dept. Agr.)

TYPHLOCYBA GILLETTEI, var. VENUSTA, new variety

General color whitish to lemon yellow, tegmina from crossveins posteriorly (apical cells sometimes nearly hyaline), and from middle of clavus anteriorly (except forward costal margin), and scutellum, dusky to black.

Holotype and paratype.—Males, Milwaukee, Wis., July 30, 1917, E. D. Ball (Ball); paratype male, New York (Kans. Univ.); allotype female, Toronto, Ont., August 8, 1924, E. D. Ball (Ball).

TYPHLOCYBA GILLETTEI, var. SELLATA, new variety

Ground color whitish to stramineous, tegmina from crossveins to base, except costal plaque dusky, apical cells fumose.

Holotype.—Female, Batavia, N. Y., August 12, 1916, on *Quercus macrocarpa*, H. H. Knight, (Kans. Univ.); paratype female, Botanic Garden, New York, N. Y., July 7, 1921, on *Quercus macrocarpa*, H. L. Sanford (U.S.N.M.).

Paratype.—Cat. No. 28493, U.S.N.M.

TYPHLOCYBA GILLETTEI, var. VESTITA, new variety

Ground color above golden yellow, which remains evident particularly on vertex, front of pronotum, costal margins of tegmina, and on crossveins, but elsewhere is more or less heavily overlaid with fumose to sooty coloring, deepest on scutellum; underparts pale yellowish. In richly colored specimens the costa posterior to plaque, posterior portions of sectors, and crossveins, are reddish.

Holotype.—Male, allotype female, and paratypes Douglas County, Kansas, August 1923, W. Robinson; paratypes: Douglas County, Kans., May 21, 1923, Paul B. Lawson (Kans. Univ.); Onaga, Kans., Buffalo, N. Y., E. P. Van Duzee (Ball).

TYPHLOCYBA POMARIA, new species

Male.—Head and thorax pale yellow, more or less tinged with orange to reddish on front of vertex; tegmina hyaline, the costa, commissure and sectors yellow, apical cells faintly dusky; underparts pale yellowish, the face more or less tinged with orange to reddish, touches of this higher coloration elsewhere also on some specimens.

Hypopygium (fig. 59): Strongly distinguished by the falcate process forming the posterior border of the side of the 9th segment, which is heavily chitinized and black in color; as the correlation of this falcate process with the type of aedeagus here illustrated for this species has thus far been constant, it results that the species can be recognized from the superficial aspect of the hypopygium, the black tips of the falces being easily seen. Near the upper posterior border of the falx are several backwardly directed bristly hairs;

similar but shorter hairs form a row on the outer clasper, and longer softer hairs spring from the under side of this clasper, from the lower border of the 9th segment near articulation of outer clasper, and from the end of the anal tube. Outer claspers as seen from below depressed interiorly so that together they inclose a long narrow sunken area, clasper as a whole narrowed on posterior third, the apices somewhat spatulate and divergent; seen from side the outer clasper is curved upward at the beginning of its posterior third, in almost a right angle, apex somewhat spatulate and recurved; inner clasper slender, outcurved apically (fig. 60); the aedeagus as seen from above (fig. 61) with a median and two lateral branches, the former considerably shorter than the latter, furcate at the tip, and reinforced along the lower surface by two longitudinal strips extending nearly to the apex appearing as ribs on back of aedeagus as seen from above; lateral processes becoming very slender apically the terminal portion curved outward and then forward. Aedeagus measured along curve, fully twice as long as connective (fig. 62).

Female.—Paler than male, general coloration stramineous, with little or no yellow, orange, or reddish washing; tip of ovipositor sheath black. Eighth sternite, moderately pointed medially and emarginate laterally (fig. 103).

Length, 3–3.5 mm.

Holotype.—Male, allotype female, and paratypes, West Chester, Pa., 7.6.16, Quaintance No. 11709, on apple, A. J. Ackerman (U.S.N.M.); Paratypes: Smith's Cove, Nova Scotia, October 4, 1915 (U.S.N.M.); South Amherst, Mass., June 17, 1924 (Ball); Cabin John Bridge, Md., June 17, 1915, Roberts (U.S.N.M.); Leesburg, Va., September 24, 1919, on apple, L. A. Stearns (McAtee); Vineland, Ont., August, 1922, W. Robinson (Kans. Univ.); Clayton, Ill., September 30, 1916; Olney, Ill., September 21, 1916, on apple; Urbana, Ill., September 20, 1916 (Ill. State. Nat. Hist. Survey); Iowa, Ac. Cat. 206 (Ball); Bentonville, Ark., September 1, 1925, on apple, A. J. Ackerman (U.S.N.M.); Douglas County, Kans., August, 1923, W. Robinson; Winona County, Minn., July 1, 1922, P. B. Lawson (Kans. Univ.); Boulder, Colo., Cockerell; Colorado, No. 1892 (U.S.N.M.), No. 1888 (State Coll. Iowa); Fort Collins, Colo., June 20, 1902, on apple (Ball); Fort Collins, Colo., September 4, 1886, on apple, J. Cassidy (U.S.N.M.).

Specimens not good enough to be made paratypes: Malden, Mass., June, 1895, F. H. Sprague (M.C.Z.); Copeley, Va., October 6, 1903, injurious to orchards, Eugene C. Massie (U.S.N.M.).

Females unassociated with males, probably of *pomaria*: Milton, Can., Uhler Coll.; Montmorency, Can., Uhler Coll.; Burlington, Vt., on apple, September 15, 1890, No. 4915, A. B. Cordley; Washington, D. C., September 5; Washington, D. C., October 5, 1904, on black-

berry, O. Heidemann; District of Columbia, June 8, 1873, on apple (U.S.N.M.); Falls Church, Va., October 6, on apple, N. Banks (M. C. Z.); Winchester, Va., September 29, 1908, on apple, Quaintance No. 4347; Iowa, Gillette, Acc. Cat. No. 161 (U.S.N.M.).

This is the species that has most often been identified as *T. rosae* Linnaeus.

Holotype, allotype, and paratypes.—Cat. No. 28494, U.S.N.M.

TYPHLOCYBA ATHENE, new species

Male.—Pale yellowish, the tegmina with a greenish cast, apical cells hyaline, underparts stramineous. Hypopygium: Upper posterior angle of 9th segment produced as a stout, somewhat decurved tooth, the lower angle as a prominent, recurved, conical tooth, which is heavily pigmented, posterior margin of segment between the processes, convex (fig. 63). Outer clasper unusually long and slender, tapered gradually on the basal three-fourths, then upcurved, and abruptly narrowed, the apical fourth quite slender, distinctly outcurved, somewhat spatulate apically, and pigmented. Inner clasper hairy at base, slender, outcurved, the apex upwardly, and somewhat anteriorly curved, aciculate. Aedeagus thrice as long as connective, the central shaft rather stout, bifid apically into long, slender, divergent aciculate processes; at about the middle of whole aedeagus two lateral arms arise from the central shaft, their tapering pointed extremities about the same length as the apical processes of the central shaft and paralleling them so closely as to conceal them from the side (figs. 64–65).

Length, 3.5 mm.

Holotype.—Male Urbana, Ill., June 7, 1916, J. R. Malloch (Ill. State Nat. Hist. Survey).

TYPHLOCYBA ARSINOE, new species

Male.—Head, thorax, and underparts stramineous, tegmina whitish hyaline, apical cells faintly fumose. Hypopygium: Upper posterior angle of 9th segment rounded, lower receding, produced at juncture with lower margin into a short, blunt process the apex of which is heavily pigmented, (and visible from below between the outer claspers); outer claspers rather slender and gradually tapered; inner of the simply curved and acuminate type; aedeagus with three slender upcurved branches from base, the lateral ones nearly as long as the median, acute apically, the medium one blunt apically and provided with two widely divergent, upwardly and outwardly curved acuminate process (fig. 66).

Female.—Pale greenish yellow, apical cells hyaline; underparts stramineous, tip of beak reddish; claws and apex of ovipositor sheath black. Eighth sternite almost evenly convex laterally, but moderately pointed medially.

Length, 3.5–3.8 mm.

Holotype.—Male, and allotype female, Boston, Mass., August 31, 1919, E. D. Ball (Ball).

TYPHLOCYBA ANDROMACHE, new species

Male.—Head and thorax stramineous, tegmina hyaline tinged with yellowish especially on veins and margins. Underparts stramineous. Hypopygium: Upper posterior angle rounded, hind margin nearly straight, lower angle slightly produced, black-tipped, the lower margin a little sinuate anterior to the tooth. Outer claspers gradually narrowed from base for three-fourths of their length, then abruptly, the apex compressed, black-margined, the tip rounded as seen from side. Inner claspers slender, rather straight for basal three-fourths, then outcurved and aciculate. Aedeagus three-parted from base, the lateral processes somewhat longer than the central one, acuminate apically, the central shaft slightly bifid and two-pointed (fig. 67).

Length, 3.5 mm.

Holotype.—Male, Salem, N. Y., June 27, 1924, on birch, E. D. Ball (Ball).

TYPHLOCYBA MELITE, new species

Male.—Body whitish to pale yellowish above and below, tegmina nearly hyaline, apical cells sometimes slightly fumose. Hypopygium: Upper posterior angle of 9th segment rounded off, lower developed as a short, blunt, downwardly projecting tooth (fig. 70). Outer claspers gradually narrowed on basal two-thirds, more decidedly on apical third, apex somewhat spatulate and heavily pigmented; a line of short bristles on upper edge of outer clasper, and longer hairs along posterior margin of 9th segment, above tooth, in region of articulation of outer clasper, and on anal tube. Inner clasper slender, curved outwardly, most so near apex, which is aciculate. Aedeagus three-parted almost from base, the lateral processes extending nearly as far posteriorly as the central one, each lateral process shaped somewhat like the letter L, the shorter arm projecting laterally as seen from above and abruptly angulate apically; tip of central process bifid, the divisions tapering rapidly, curving outward and backward, and sharp-pointed (figs. 68–69).

Female.—Colored like male; eighth sternite almost evenly convex posteriorly, slightly emarginate medially.

Length, 3.75–4 mm.

Holotype.—Male, Colorado, No. 1584, C. F. Baker Collection (U.S.N.M.); paratypes both sexes (and allotype), Sea Cliff, N. Y., some labeled "August," others " on gooseberry," N. Banks (M. C. Z.)

Holotype.—Cat. No. No. 28495, U.S.N.M.

TYPHLOCYBA NITIDULA Fabricius

Cicada nitidula Fabricius, J. C., Systema Rhyngotorum secundum ordines, genera, species, adiectis synonymis, locis, observationibus, descriptionibus, 1803, p. 79 [Paris, France].

"Pale yellow; the scutellum, a broad band across the base of the elytra, and another across the apex of corium, blackish brown. Membrane whitish hyaline. Claws fucous." The variety *norgueti* Lethierry, has the space between the two bands on the elytra filled up with blackish brown.

Length, 3.3–3.6 mm.

James Edwards, from whose work on the Homoptera of the British Island (1896, p. 219), the above description is quoted, has kindly supplied me with a male *T. nitidula*, var. *norgueti* which has enabled me to present the following details relating to the Hypopgium: Upper posterior angle of 9th segment rather produced, subangulate, and incurved, the lower receding, the surface of the segment in general well-haired; outer claspers narrowing gradually, to the bluntly rounded apices, inner claspers of ordinary form, the apices outcurved and acute; aedeagus with a very short base from which arise at almost right angles, two straight, tapering, moderately pointed processes, above which there is an unpaired, shorter, upcurved processes, giving a "two-storied" aedeagus, a type seen in only one other species, *T. modesta* Gibson (figs. 71–72).

The eighth sternite of females from England in Baker Collection is almost evenly convex posteriorly.

Distribution: *Typhlocyba nitudula* ranges from Russia over northern and central Europe. It has been recorded[17] from Mount Washington, N. H., by Mrs. Annie Trumbull Slosson. In the present study no specimen of the true *nitidula* has been found, and it is suggested that the Slosson record may be based on one of the varieties of *T. gillettei* or *T. cymba.*

TYPHLOCYBA MODESTA Gibson

Typhlocyba modesta Gibson, E. H., Three new species of Jassoidea from Missouri, Can. Ent., vol. 49, no. 5, May, 1917, p. 184 [Charleston, Mo.].

Male.—Head, thorax, and underparts stramineous, tegmina nearly hyaline, faintly dusky apically. Hypopygium with the side of the ninth segment strongly produced in a lobe which is provided with a projecting tooth both above and below, the upper the longer, and more curved and acute (fig. 73), sometimes pigmented; outer clasper narrowed on apical third, the apex slightly spatulate and heavily

[17] Additional list of insects taken in Alpine region of Mount Washington, Ent. News, vol. 17, No. 9, November, 1906, p. 326.

pigmented. Inner claspers strongly curved, abruptly tapered near tip which is aciculate. Aedeagus remarkable in having two medially situated shafts, the uppermost of which is short, upcurved, simple and acute at apex, and the lower much longer, upcurved, bifid on its apical fourth, the rami parallel, a little expanded subapically, tapered apically and slightly curved outwardly and backwardly (figs. 74–75).

Female.—Coloration as in male, a little more tinged with yellow, especially on head. Eighth sternite decidedly emarginate medially (fig. 106); apex of ovipositor sheath black.

Length, 3.5–3.75 mm.

Holotype and paratype.—Females, Charleston, Mo., June 7, 1916; allotype male, same locality May 18, E. H. Gibson (U.S.N.M.). Other specimens seen are from Falls Church, Va., May 30, N. Banks (M. C. Z.); Glencarlyn, La., June 11, 12, 16, 1925, J. R. Malloch (McAtee); Urbana, Ill., August 28, 1917, October 11, 1914 (Ill. State Nat. Hist. Survey); Ames, Iowa, June 19, 1897, September 25, 1889, (State Coll. Iowa); Ames, Iowa, June 19, 1897 (Ball).

Holotype, allotype, and paratype.—Cat. No. 21, 393, U.S.N.M.

TYPHLOCYBA 6-NOTATA Van Duzee

Empoa querci, var. *6-notata* Van Duzee, E. P., A preliminary List of the Hemiptera of San Diego County, Calif., Trans. San Diego Soc. Nat. Hist., vol. 2, no. 1, Nov., 1914, p. 57 [Alpine, Calif.]

Female.—Vertex and pronotum pale yellowish, the pronotum with a deeper yellow round spot on center of disk; scutellum fulvous, paler centrally at base; tegmen rather bluish green hyaline, a greenish-yellow vitta just exterior to claval suture, the apical cells dusky, dusky spots anterior to crossveins of which the innermost is largest and darkest, a black dot at middle and another at base of inner claval margin; commissure blackish near apex of scutellum, yellowish posteriorly. Dorsum of abdomen chiefly blackish, underparts pale yellowish. Eighth sternite nearly straight across hind margin, very slightly emarginate laterally and very briefly and indistinctly pointed medially.

Length, 3.5 mm.

Spreckels, Calif., September 10, 1907, E. D. Ball; October 5, 1907, on sugar beets, Titus and Ball (Ball).

TYPHLOCYBA PHRYNE, new species

Female.—Ground color of head and thorax pale yellowish, tegmina whitish hyaline, with the following markings, median seamlike line from back of vertex and two spots at middle of vertex translucent allowing the darker subcutaneous parts to show through; two spots on hind margin of vertex unite with two curved vittae on

pronotum and scutellum to produce a heavy black parentheses-like marking; inner margins of tegmina from base to crossveins with a pronounced black edging; distinct black spots anterior to crossveins 2, 3, and 4; membrane fumose hyaline. Underparts stramineous, claws and entire ovipositor brown. Eighth sternite emarginate both laterally and medially.

Length, 3.5 mm.

Holotype.—Female, Urbana, Ill., July 9, 1920 (Ill. State. Nat. Hist. Survey).

Another female Ames, Iowa, October 15, 1897 (State. Coll. Iowa) is made the type of the variety *subpulchra*, new variety; it lacks the dark parentheses on thorax and the commissural marking is much narrower.

Group 3

Besides the characters mentioned in the key, common features of species of this group are aedeagus bifid, more or less caliper-like, and dark spots anterior to crossveins.

KEY TO THE SPECIES OF GROUP 3

1. Dusky spots anterior to crossveins rather elongate, sometimes forming an ill-defined band 2
— Spots anterior to crossveins not elongate 3
2. Outer clasper of male with a distinct process exteriorly near apex (figs. 96–97); eighth sternite of female emarginate medially
appendiculata Malloch, p. 39
— Outer clasper of male without process. (Two alternatives.)
Aedeagus as in figs. 77–78 ..... antigone, new species, p. 35
Aedeagus as in figs. 81–82 ..... clymene, new species, p. 36
3. Apical cells with decided dusky markings, aedeagus as in figures 90 and 94 ..... hermione, new species, p. 38
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Aedeagus as in figs. 88–89 ..... berenice, new species, p. 38
Aedeagus as in figs. 85–86 ..... eurydice, new species, p. 37
Aedeagus as in figs. 79–80 ..... nicarete, new species, p. 36
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TYPHLOCYBA ANTIGONE, new species

Male.—Head and thorax pale yellowish, tegmina nearly to crossveins, light sulphur yellow; somewhat elongate spots anterior to crossveins 2, 3, and 4, faintly dusky; apical cells hyaline; underparts stramineous. Hypopygium: Posterior lateral margin of ninth segment distinctly emarginate, the upper angle developed as a process resembling in shape, as seen from above or below, a thumb and index finger, but appearing as an acute tooth as seen from side (fig. 76), the finger much longer than the thumb and decidedly incurved: claspers in no way unusual, aedeagus short, widely bifid apically,

caliper-like, the arms strongly incurved, then at extreme apex decurved and pointed (figs. 77–78).

Length, 3.5 mm.

Holotype.—Male White Heath, Ill., June 24, 1916, on oak (Ill. State Nat. Hist Survey); paratype males, Glencarlyn, Va., June 12, 16, 20, 1925, J. R. Malloch (McAtee).

In the holotype the third apical vein is not quite in line with the third sector, hence this species has been keyed in Group 2 as well as 3; the characters of the aedeagus, however, indicate that the species is best placed in the latter group.

TYPHLOCYBA NICARETE, new species

Male.—Vertex pale yellowish, thorax stramineous, tegmina whitish hyaline, with small dusky spots anterior to cross veins 2, 3, and 4, apical cells slightly fumose; underparts stramineous. Hypopygium: Posterior margin of ninth segment squarish as seen from side, with an interior lengthwise, nearly median, chitinous supporting strip, and another along margin, which unite to form a support shaped like a falx of *T. pomaria* (fig. 59), which reaches the apex of the rather pointed lower angle, upper angle rounded. Outer clasper of ordinary form, narrowed on apical third; inner almost semicircularly curved, the pair tangent to each other in the middle ventrally, the apices aciculate, directed outwards and barely extending beyond sides of outer claspers. Aedeagus short, stout, bifurcate from middle, the arms, curved, stout, caliper-like, each abruptly constricted at apex into a thornlike appendage which is directed downwardly and inwardly (figs. 79–80).

Female.—Colored like male, apex of ovipositor sheath black; eighth sternite evenly convex posteriorly.

Length, 3–3.5 mm.

Holotype.—Male, and three females assigned to the species because of identical data, White Heath, Ill., June 24, 1916, on oak (Ill. State Nat. Hist. Survey); paratype male, Urbana, Ill., June 17, 1916; paratype males and associated females, Virginia near the District of Columbia, June 15, 1924; Salem N. Y., June 27, 28, 1924, E. D. Ball (Ball); paratype males, Glencarlyn, Va., June 12, 16, 20, J. R. Malloch (McAtee).

TYPHLOCYBA CLYMENE, new species

Male.—Stramineous above, scutellum a little deeper yellowish, tegmina whitish hyaline, elongate dark spots anterior to cross veins 2, 3, and 4, nearly coalesced in a band; underparts stramineous. Hypopygium: Upper posterior angle of ninth segment produced

upward and incurved, acute at apex, the lower angle well rounded. Claspers of ordinary form. Aedeagus short, bifurcate in stout caliper-shaped rami, which subapically are abruptly narrowed and curved downward and inward, terminating in slender acute processes (figs. 81–82).

Length, 3.75 mm.

Holotype.—Male, McLean, N. Y., July 14, 1919, John L. Buys (McAtee). Aedeagus of holotype lost.

TYPHLOCYBA DANAE, new species

Male.—Whitish above tending to pale ivory on vertex and thorax; tegmina whitish hyaline, with small dusky spots anterior to cross veins 2, 3, and 4, apical cells slightly fumose; underside stramineous. Hypopygium: Upper posterior angle of ninth segment with two strong inwardly curved teeth, the emargination between them U-shaped (fig. 83), lower angle slightly produced downwardly; outer claspers narrowed from base outbowed for about two-thirds their length, then incurved; the apices slightly divaricate, rounded; inner claspers of the simple outcurved type, acute apically; aedeagus resembling that of *T. eurydice*, but much larger, more than twice as long as connective, the base more slender, and the angulation of rami less abrupt (fig. 84).

Female.—Coloration as in male, apex of ovipositor sheath black; eighth sternite evenly convex posteriorly.

Holotype.—Male and allotype female, and another pair, Conesus Lake, N. Y., July 16, 1916, in copula, H. H. Knight (Kans. Univ.); paratype males, Glencarlyn, Va., June 12, 16, 20, 23, J. R. Mallach (McAtee).

TYPHLOCYBA EURYDICE, new species

Male.—Whitish above, a little yellowish showing through vertex and scutellum; tegmina whitish hyaline, with small dusky spots anterior to crossveins 2, 3, and 4, and the apical cells fumose marginally; underparts stramineous. Hypopygium: Upper posterior angle of ninth segment, produced, incurved, and acute (fig. 87), lower angle rounded; outer clasper abruptly narrowed beyond middle to about a third of its basal width, the apex slightly spatulate; inner clasper rather thick and tortuous basally, abruptly tapering beyond middle, simply curved and acute apically; aedeagus short, no longer than connective, with a stout base, then bifurcate for three-fourths of its length, the rami rather angulate, directed outwardly, then downwardly, the slender acute apices crossing (figs. 85–86).

Female.—Like the male in color, apex of ovipositor sheath black; eighth sternite slightly emarginate laterally, very moderately pointed medially.

Length, 3.5 mm.

Holotype.—Male and allotype female, Beltsville, Md., June 23, 1916, on *Quescus alba*, taken in copula; paratype females same data; paratype male, Odenton, Md., July 12, 1914, W. L. McAtee (McAtee).

A male with same data as holotype, which almost entirely lacks dusky markings, may be taken as the type of var. *discincta*, new variety; it has a slight yellowish wash on tegmina, especially along costa near crossveins.

TYPHLOCYBA BERENICE, new species

Male.—Pale yellowish overlaid with whitish; tegmina whitish hyaline, small dusky spots in front of cross veins 2, 3, and 4, apical cells with dusky clouding marginally; underparts stramineous. Hypopygium: Upper posterior angle of ninth segment rounded protuberant (fig. 91) without inner teeth as in *T. danae*, posterior margin nearly vertical, lower angle rather squarish. Outer claspers of ordinary form, the apices rounded; inner claspers simply curved and acute pointed. Aedeagus with short base, from which arise two slender, outcurved arms which approach subapically where each emits a slender very acute, inwardly and downwardly curved process, apices of main branches of aedeagus, acute, slightly curved posteriorly (figs. 88–89).

Length, 3.5 mm.

Holotype.—Male, Rock Creek, D. C. June 19 (U.S.N.M.); paratype, male, Toronto, Ont., August 8, 1924, E. D. Ball (Ball).

Holotype.—Cat. No. 28496, U.S.N.M.

TYPHLOCYBA HERMIONE, new species

Male.—Head and thorax whitish to stramineous, tegmina whitish hyaline, with small dark spots anterior to cross veins 2, 3, and 4, and the apical cells with considerable dusky clouding, sometimes with rather well defined elongate spot along the inner side of cell 1; underparts stramineous, lower part of face yellowish. Hypopygium: Upper posterior angle well produced, rounded as seen from side (fig. 93), incurved and pointed as seen from above or below; in the latter view distinct serration of the margin is visible, as well as a prominent incurved spine a little basad of apex (fig. 92); posterior border of ninth segment nearly straight, receding, lower angle almost eliminated. Apical third of outer clasper decidedly narrowed, somewhat outcurved and slightly spatulate apically. Inner clasper

narrowed from base, outcurved, acute apically. Aedeagus with two stout but rapidly tapering divergent rami, which are abruptly incurved at two-thirds of their length and terminate in delicate acute processes which cross apically; on the abrupt angle is a short acute thorn which is difficult to see except in exact profile (figs. 90 and 94).

Length, 4 mm.

Holotype.—Male, Washington, D. C., July 2, 1913; paratype males: Bluemont, Va., July 1, 1914, W. L. McAtee (McAtee); Madison, Wis., August 11, 1918, E. D. Ball (Ball).

TYPHLOCYBA APPENDICULATA Malloch

Typhlocyba appendiculata MALLOCH, J. R., A new species of Typhlocyba (Hemiptera Homoptera, Typhlocybidae), Can. Ent., vol. 52, no. 4, April 1920, p. 95 [Elizabeth, Ill.].

Male.—Head and thorax pale yellowish, tegmina whitish hyaline with a broad dusky band anterior to crossveins, which is sometimes reduced to poorly defined elongate spots, some specimens with more or less dusky clouding also on anterior part of corium and on clavus, apical cells slightly fumose (fig. 10); underparts stramineous. Hypopygium: Upper posterior angle of ninth segement rounded acute and incurved; as seen from side, the posterior margin slightly emarginate (fig. 95) in the lower two-thirds, and the upper end of the emargination is a small tooth; lower angle a little produced downwardly; outer surface bristly and rugose, margin serrulate interiorly. Outer clasper gradually narrowed from base for about two-thirds of its length where a strong, somewhat falcate, fairly acute pointed process is given off externally (figs. 96–97); portion of clasper beyond this point gradually tapering, rounded at apex. Inner clasper broad at base, gradually tapered to the acute outwardly directed apex, curved so that the inner margin forms almost a quarter circle (fig. 98). Aedeagus with a slender stem between connective and the bifurcation; the rami are stout, outcurved, appearing from above like the cross-section of a goblet, each is downcurved and incurved apically in the form of a long pointed process (fig. 99.) For clearness only one of the processes is shown in drawing.

Female.—Coloration as in male. Eighth sternite slightly emarginate laterally, convex medially.

Length, 3.5 mm.

A male and several females, Urbana, Ill., July 9–20, 1920, one female Elizabeth, Ill., July 8, 1917, (Ill. State Nat. Hist. Survey); Ames, Iowa, September 11, 1919, E. D. Ball; June 19, 1897 (Ball); Washington, D. C., June 18, 29, 1925, W. L. McAtee (McAtee).

LIST OF NUMBERS USED FOR HYPOPYGIA AND THE NAMES OF SPECIES TO WHICH THEY PERTAIN

It seems desirable to place on record these numbers and their equivalents, as tickets bearing them have been placed on numerous specimens, some of which may later become separated from their name labels.

1. *pomaria*, new species.
2. *commissuralis* Stal.
3. *pomaria*, new species.
4. Not used.
5. *cymba* McAtee.
6. *gillettei* Van Duzee.
7. *hermione*, new species.
8. *flavomarginata* Gillette and Baker.
9. *modesta* Gibson.
10. *ulmi* Linnaeus.
11. Not used.
12. *xanthippe*, new species.
13. *rosae* Linnaeus.
14. *berenice*, new species.
15. *eurydice*, new species.
16. Not used.
17. *melite*, new species.
18. *ariadne*, new species.
19. *ariadne*, new species.
20. *rosae* Linnaeus.
21. *commissuralis* Stal.
22. *rubriocellata* Malloch.
23. *nicarete*, new species.
24. *antigone*, new species.
25. *piscator*, new species.
26. *clymene*, new species.
27. *lethierryi* Edwards.
28. *appendiculata* Malloch.
29. *arisinoe*, new species.
30. *unca*, new species.
31. *persephone*, new species.
32. *euphrante*, new species.
32a. *ariste*, new species.
33. *niobe*, new species.
34. *lancifer*, new species
35. *danae*, new species.
36. *athene*, new species.
37. *duplicata*, new species.
38. *andromache*, new species.

CORRELATION OF THE NOMENCLATURE OF THE VAN DUZEE CATALOGUE[18] WITH THAT OF THE PRESENT PAPER

Genus *Empoa* Fitch=*Typhlocyba* Germar (See Proc. Biol. Soc. Wash., vol. 31, 1918, pp. 112–113, 114–115).

Empoa querci Fitch=*Typholcyba* gillettei Van Duzee, p. 23.

Empoa querci, var *gillettei* Van Duzee=*Typhlocyba gillettei*, var *gillettei* Van Duzee, p. 27.

Empoa querci, var *6-notata* Van Duzee=*Typhlocyba 6-notata* Van Duzee, p. 34.

Empoa querci, var *morgani* De Long. See entry under De Long, p. 41.

Empoa nitidula Fabricius=*Typhlocyba nitidula* Fabricius, p. 33.

Empoa aureotecta Sanders and De Long=*Typhlocyba aureotecta* Sanders and De Long, pp. 20, 26.

Empoa australis Walsh. See entry under Walsh, p. 42.

Empoa flavomarginata, Gillette and Baker=*Typhlocyba flavomarginata* Gillette and Baker, p. 17.

Empoa ulmi Linnaeus=*Typlocyba ulmi* Linnaeus, p. 5.

Empoa commisuralis Stal=*Typhlocyba commisuralis* Stal, p. 11.

Empoa tenerrima Herrich-Schaeffer=*Typhlocyba tenerrima* Herrich-Schaeffer, p. 6.

Empoa lethierryi Edwards=*Typhlocyba lethierryi* Edwards, p. 15.

Empoa rosae Linnaeus=*Typhlocyba rosae* Linnaeus, p. 13.

Empoa fabae Harris. See entry under Harris, p. 42.

Empoa albicans Walsh. See entry under Walsh, p. 42.

Empoa modesta Gibson=*Typhlocyba modesta* Gibson, p. 33.

[18] Univ. Calif. Publ. Tech. Bull. Ent. Vol. 2, 1917, pp. 708–711, 827.

PUBLICATIONS CONTAINING NAMES UNPLACED IN THIS PAPER.

BAKER, C. F.

New Typhlocybini, Invertebrata Pacifica, vol. 1, pp. 5–9, Sept. 15, 1903.

Typhlocyba pseudo-maculata, new species, p. 8[Champerico, Guatemala], *Typhlocyba verticis*, new species, pp. 8–9 [Managua, Guatemala], *Typhlocyba pseudo-obliqua*, new species, p. 9 [Managua, Guatemala], *Typhlocyba bimaculata*, new species, [Champerico, Guatemala; Acapulco, Mexico]. Probably none of these belong to the genus Typhlocyba in the sense of this paper.

BERG, CARLOS

Hemiptera Argentina enumeravit speciesque novas descripsit, 1879, 316 pp.

Typhlocyba photophila, new species, pp. 273–274 [Corrientes, Argentina]; *Typhlocyba salinarum*, pp. 274–275 [Buenos Aires, Argentina].

Addenda et Emendanda ad Hemiptera Argentina, 1884, 213 pp.

Typhlocyba centralis, new species, p. 175 [Chaco, Argentina].

Hemipteros de la Tierra del Fuego, Anales Mus. Nac. Buenos Aires, vol. 4, (ser. 2, vol. 1) 1895, pp. 195–206.

Typhlocyba fulgidula, new species, p. 205 [Filaret, Argentina].

DE LONG, D. M.

The Leafhoppers or Jassoidea of Tennessee, Bull. No. 17 (vol. 4, no. 2), Tenn. State Board Ent., June 1916, 113 pp., 20 figs.

Typhlocyba osborni, new species, pp. 103–104, figs. 19–20 [Clarksville, Tenn.], *Typhlocyba morgani*, new species, p. 104, fig. 18 [Clarksville, Tenn.], and *Typhlocyba nigridorsum*, new species, p. 110 [Clarksville, Tenn.] belong to the genus Erythoneura Fitch. (See Trans. Amer. Ent. Soc., vol. 46, 1920, pp. 267–321).

Some new Cicadellidae (Homoptera) from the Southern United States, Journ. N. Y. Ent. Soc., vol. 32, no. 1, March 1924, pp. 63–69, pl. 7.

Empoa minutus, new species, p. 68, pl. 7, figs. 7, 7*a* [Miami, Florida].

FITCH, ASA

Catalogue with references and descriptions of the insects collected and arranged for the State Cabinet of Natural History, Fourth Ann. Rep. Regents Univ., N. Y., on the State Cabinet of Natural History, 1851, pp. 48–69.

Of the two species described in genus *Empoa*, one, *querci*, is disposed of on p. — of the present paper, and the other, *coccinea*, is said by Dr. E. D. Ball to belong to the genus *Empoasca* Walsh.

GILLETTE, C. P.

American Leaf-hoppers of the Subfamily Typhlocybinae, Proc. U. S. Nat. Mus., vol. 20, 1898, pp. 709–773, 149 figs.

Of the 23 species included in the genus Typhlocyba, ten belong to the genus *Erythroneura* Fitch (See Trans. Amer. Ent. Soc., vol. 46, 1920, pp. 267–321); one has been removed to the genus *Hymetta* McAtee (See Proc. Biol. Soc. Wash., vol. 32, pp. 121–124, June 1919); and nine are retained in the genus *Typhlocyba* and are treated in the present revision. The others, *Empoa coccinea* Fitch, *Typhlocyba centralis* Berg, and *Typhlocyba sanguinea* Gillette and Baker are mentioned under the proper entries in this bibliography.

GILLETTE, C. P., and BAKER, C. F.

A preliminary list of the Hemiptera of Colorado, Bull. No. 31 (Tech. Ser. No. 1), Colo. Agr. Coll., June 1895, 137 pp.

Typhlocyba sanguinea, new species, pp. 112–113, 2 figs. [Manitou, Colo.] No specimens have been seen and the proper generic reference is unknown.

HARRIS, T. W.

A report on the Insects of Massachusetts Injurious to Vegetation, Cambridge, 1841.

Tettigonia fabae, new species., p. 186, assigned by Van Duzee to the genus *Empoa*, with little doubt is an *Empoasca*.

SANDERS, J. G., and DELONG, D. M.

The Cicadellidae (Jassoidea-Fam. Homoptera) of Wisconsin with descriptions of new species, Ann. Ent. Soc. Amer., vol. 10, no. 1, March 1917, pp. 79–95, pls. 8–9.

Empoa aureotecta, new species, pp. 93–94, pl. 9, figs. 43–45 [Madison, Wis.]. See pp. 20, 26 of the present paper.

SANDERS, J. G., and DELONG, D. M.

New American Records and Notes of Cicadellidae, Gen. Bull. No. 346, Pennsylvania Dept. Agr., June 1920, pp. 18–19.

Empoa debilis Douglas recorded from Bound Brook, N. J. English specimens of *debilis* received from J. Edwards are not specifically distinct from *Typhlocyba ulmi* Linnaeus, and there is little in existing descriptions to persuade one to believe that *debilis* is a distinct species.

SANDERS, J. G., and DELONG, D. M.

New species of Cicadellidae (Homoptera) from the Eastern and Southern United States, Proc. Ent. Soc. Wash., vol. 24, No. 4, April 1922, pp. 93–100, pls. 11–12.

Typhlocyba inscripta, new species, pp. 99–100, pl. 12, figs. 3*a*, *b*, *c*= *Eupteryx stellulata* Burmeister.

VAN DUZEE, E. P.

Notes on Jamaican Hemiptera, A Report on a Collection of Hemiptera made on the Island of Jamaica in the Spring of 1906, Bull. Buffalo Soc. Nat. Sci., vol. 8, No. 5, 1907, 79 pp.

Typhlocyba pseudo-maculata Baker recorded from Rock Fort, Jamaica, p. 77.

WALSH, BENJAMIN D.

Fire-blight. Two new foes of the apple and pear, The Prairie Farmer, vol. 10, no. 10, September 6, 1862, pp. 148–149.

Typlocyba aurea, new species, p. 149 [Rock Island, Illinois], *Typhlocyba pallidula*, p. 149 [Southern Illinois], and *Typhlocyba binotata*, p. 149 [Rock Island, Illinois] are forms of the genus *Alebra* Fieber. *Empoa albicans*, new species [Illinois?], p. 149 is a *Typhlocyba* but unidentifiable. *Erythroneura australis*, new species, p. 149 [Rock Island, Ill.] is referred to the genus *Typhlocyba* by Van Duzee, but like the preceding species is unrecognizable in the absence of a type specimen.

EXPLANATION OF PLATES

PLATE 1

Tegmina of *Typhlocyba*

FIG. 1. *T. piscator.*
2. *T. gillettei*, var. *fitchii.*
3. *T. gillettei*, var. *fitchii.*
4. *T. gillettei*, var. *apicata.*
5. *T. gillettei*, var. *apicata.*
6. *T. gillettei*, var. *gillettei.*
7. *T. gillettei*, var. *gillettei.*
8. *T. gillettei*, var. *gillettei.*
9. *T. gillettei*, var. *gillettei.*
10. *T. appendiculata.*

Figures on this plate by J. R. Malloch.

PLATE 2

Male genitalia of *Typhlocyba*

FIG. 11. *T. ulmi*, outer clasper.
12. *T. ulmi*, inner clasper.
13. *T. ulmi*, connective and aedeagus from above.
14. *T. ulmi*, apex of aedeagus from behind.
15. *T. ulmi*, connective and aedeagus from side.
16. *T. tenerrima*, aedeagus from above.
17. *T. tenerrima*, aedeagus from side.
18. *T. unca*, aedeagus from above.
19. *T. unca*, apex of aedeagus from behind.
20. *T. unca*, aedeagus from side.
21. *T. piscator*, aedeagus from above.
22. *T. piscator*, aedeagus from side.
23. *T. persephone*, aedeagus from above; apex from side.
24. *T. euphrante*, hind margin of ninth segment.
25. *T. commissuralis*, hypopygium from side.
26. *T. commissuralis aedeagus* from above.
27. *T. commissuralis*, inner clasper.
28. *T. commissuralis*, aedeagus from side.
29. *T. euphrante*, aedeagus from side.
30. *T. euphrante*, apex of aedeagus from above.
31. *T. rosae*, aedeagus from side.
32. *T. rosae*, hind margin of ninth segment.
33. *T. rosae*, apex of aedeagus from above.
34. *T. xanthippe*, aedeagus from side, its apex from above, and upper posterior angle of ninth segment.
35. *T. ariadne*, hind margin of ninth segment.
36. *T. ariadne*, aedeagus from side and its apex from above.
37. *T. lethierryi*, aedeagus from side, and its apex from above.

Figures on this plate by the author.

PLATE 3

Male genitalia of *Typhlocyba*

FIG. 38. *T. duplicata*, aedeagus from above.
39. *T. duplicata*, apex of outer clasper from below.
40. *T. flavomarginata*, hypopygium from side.
41. *T. flavomarginata*, connective, aedeagus, and inner clasper from above.
42. *T. flavomarginata*, connective and aedeagus from side.
43. *T. tunicarubra*, aedeagus from above.
44. *T. tunicarubra*, aedeagus from side.
45. *T. lancifer*, aedeagus from above.
46. *T. lancifer*, aedeagus from side.
47. *T. niobe*, aedeagus from above, apex of one ramus of aedeagus from side.
48. *T. rubriocellata*, hind margin of ninth segment, and outer and inner claspers from side.
49. *T. rubriocellata*, aedeagus from above.
50. *T. rubriocellata*, aedeagus from side.
51. *T. cymba*, aedeagus from above, and inner clasper.
52. *T. cymba*, aedeagus from side.
53. *T. cymba*, hypopygium from side.

Figures on this plate by the author.

PLATE 4

Male genitalia of *Typhlocyba*

FIG. 54. *T. gillettei*, outer claspers from below.
55. *T. gillettei*, hind margin of ninth segment.
56. *T. gillettei*, connective, aedeagus, and outer and inner claspers from above.
57. *T. gillettei*, apex of aedeagus from behind.
58. *T. gillettei*, connective and aedeagus from side.
59. *T. pomaria*, hypopygium from side.
60. *T. pomaria*, inner clasper.
61. *T. pomaria*, connective and aedeagus from above.
62. *T. pomaria*, connective and aedeagus from side.
63. *T. athene*, hind margin of ninth segment.
64. *T. athene*, aedeagus from above.
65. *T. athene*, aedeagus from side.
66. *T. arsinoe*, aedeagus from above.
67. *T. andromache*, aedeagus from above.
68. *T. melite*, aedeagus from above.
69. *T. melite*, aedeagus from side.
70. *T. melite*, hind margin of ninth segment.
71. *T. nitidula*, aedeagus from side.
72. *T. nitidula*, aedeagus from behind.
73. *T. modesta*, hind margin of ninth segment.
74. *T. modesta*, connective and aedeagus from side.
75. *T. modesta*, apex of aedeagus from behind.

Figures on this plate by the author.

PLATE 5

Male Genitalia of *Typhlocyba*

FIG. 76. *T. antigone*, hind margin of ninth segment.
77. *T. antigone*, aedeagus from above.
78. *T. antigone*, aedeagus from side.
79. *T. nicarete*, aedeagus from above.
80. *T. nicarete*, aedeagus from side.
81. *T. clymene*, one ramus of aedeagus from above.
82. *T. clymene*, aedeagus from side.
83. *T. danae*, inner side of upper posterior angle of ninth segment as viewed from above.
84. *T. danae*, aedeagus from above (one ramus omitted).
85. *T. eurydice*, aedeagus from above.
86. *T. eurydice* aedeagus from side.
87. *T. eurydice*, hind margin of ninth segment.
88. *T. berenice*, aedeagus from above.
89. *T. berenice*, aedeagus from side.
90. *T. hermione*, connective and aedeagus from above.
91. *T. berenice*, hind margin of ninth segment.
92. *T. hermione*, upper posterior angle of ninth segment as seen from below.
93. *T. hermione*, hypopygium from side.
94. *T. hermione*, connective and aedeagus from side.
95. *T. appendiculata*, hind margin of ninth segment.
96. *T. appendiculata*, outer clasper from below.
97. *T. appendiculata*, outer clasper from side.
98. *T. appendiculata*, inner clasper.
99. *T. appendiculata*, aedeagus from above (one apical process omitted).

Figures on this plate by the author.

PLATE 6

Female Genitalia of *Typhlocyba*

FIG. 100. *T. commissuralis*, half of eighth sternite.
101. *T. gillettei*, half of eighth sternite.
102. *T. cymba*, half of eighth sternite.
103. *T. pomaria*, half of eighth sternite.
104. *T. ariadne*, half of eighth sternite.
105. *T. ulmi*, half of eighth sternite.
106. *T. modesta*, half of eighth sternite.
107. *T. rubriocellata*, half of eighth sternite.
108. *T. flavomarginata*, half of eighth sternite.
109. *T. euphrante*, half of eighth sternite.
110. *T. gillettei*, hypopygium from side, showing position of aedeagus in copulation.

Figures on this plate by the author.

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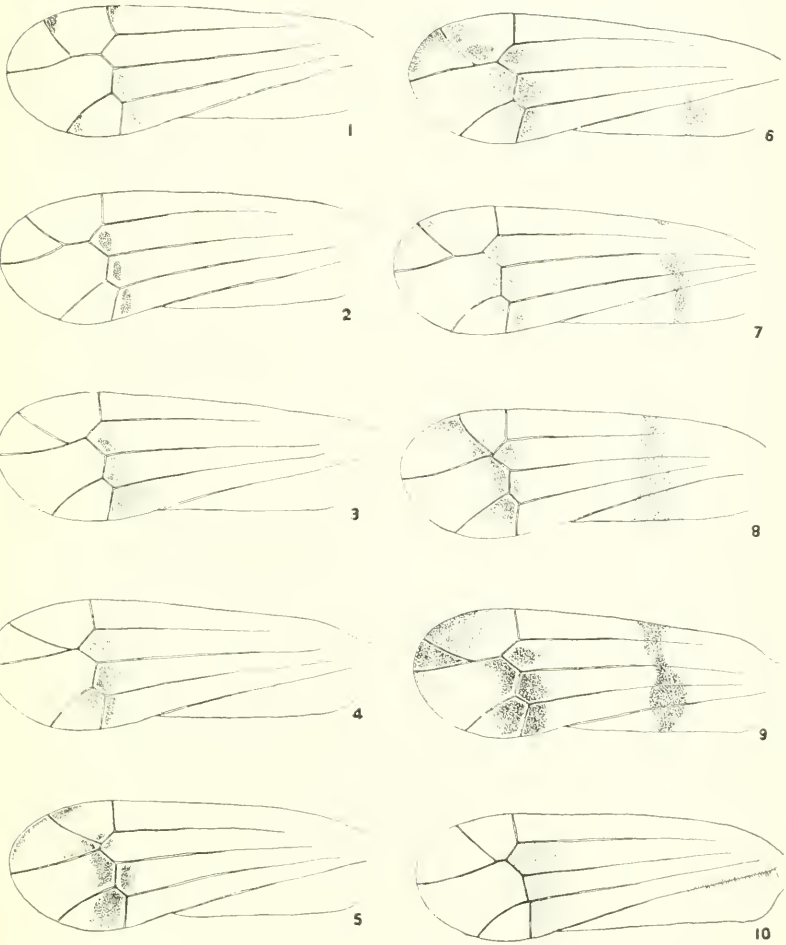

TEGMINA OF TYPHLOCYBA

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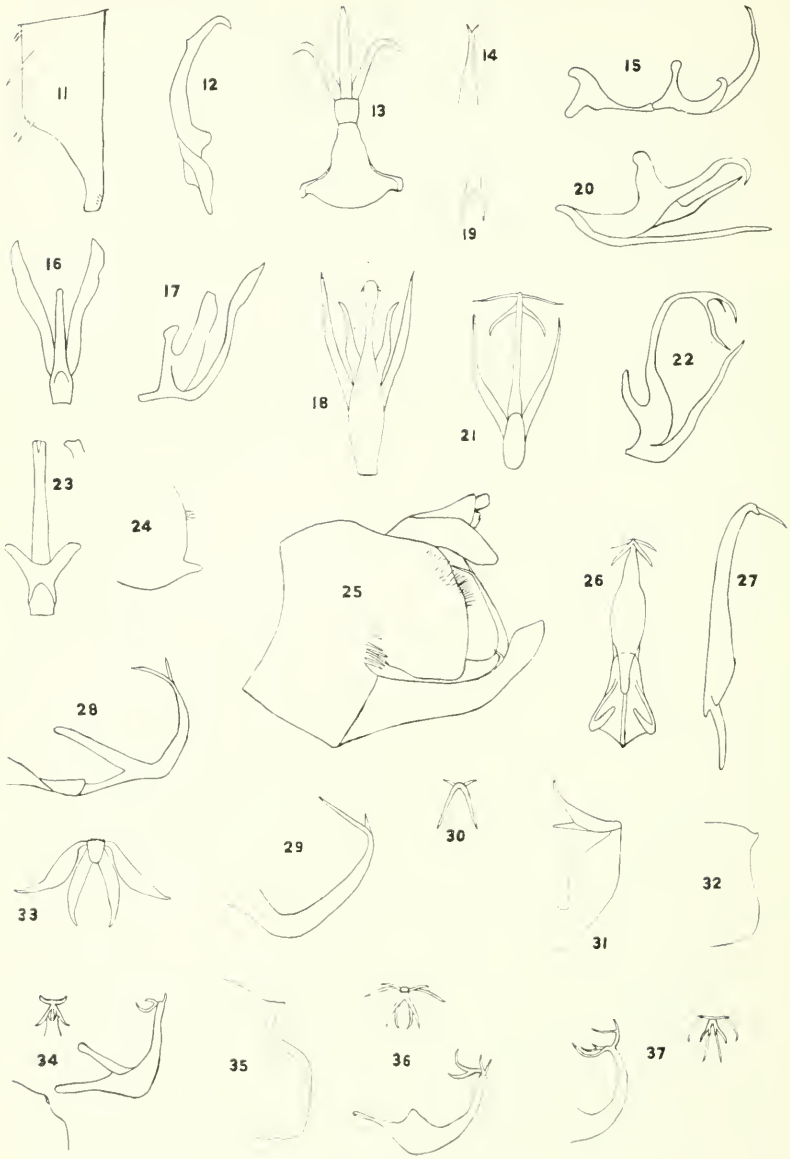

GENITALIA OF TYPHLOCYBA

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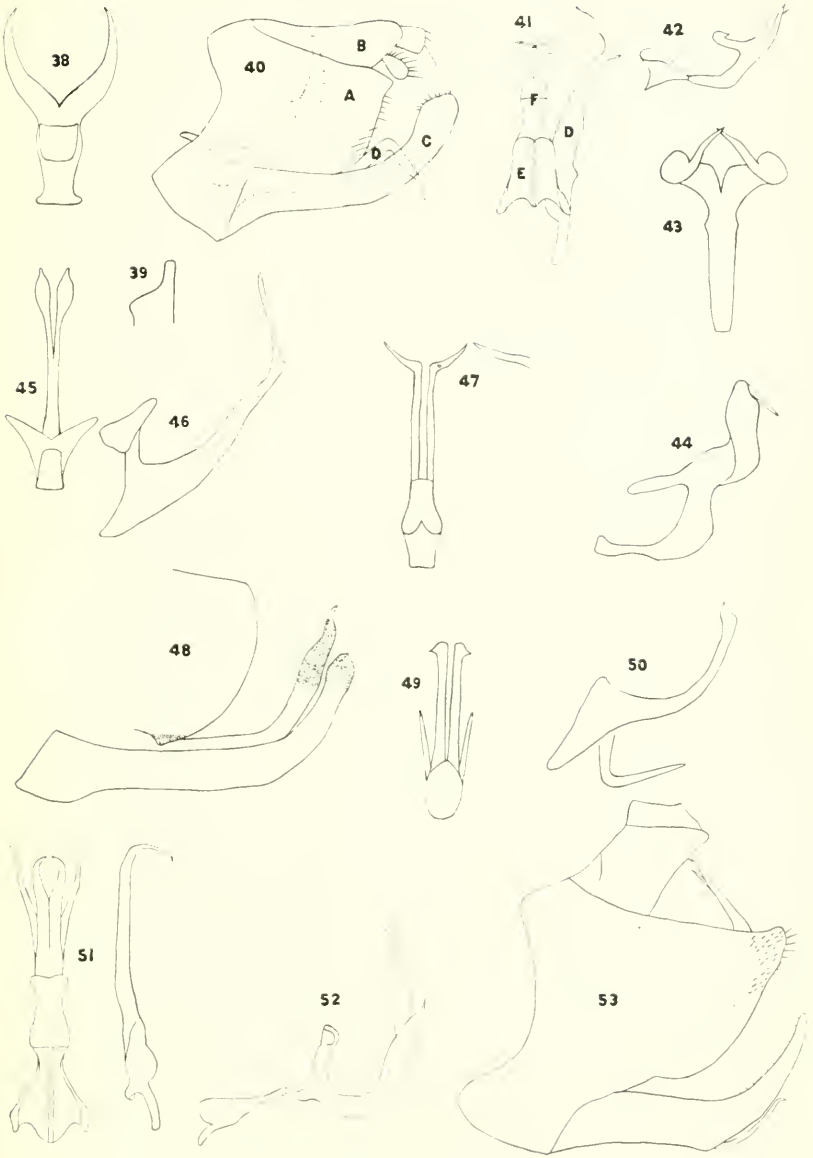

GENITALIA OF TYPHLOCYBA

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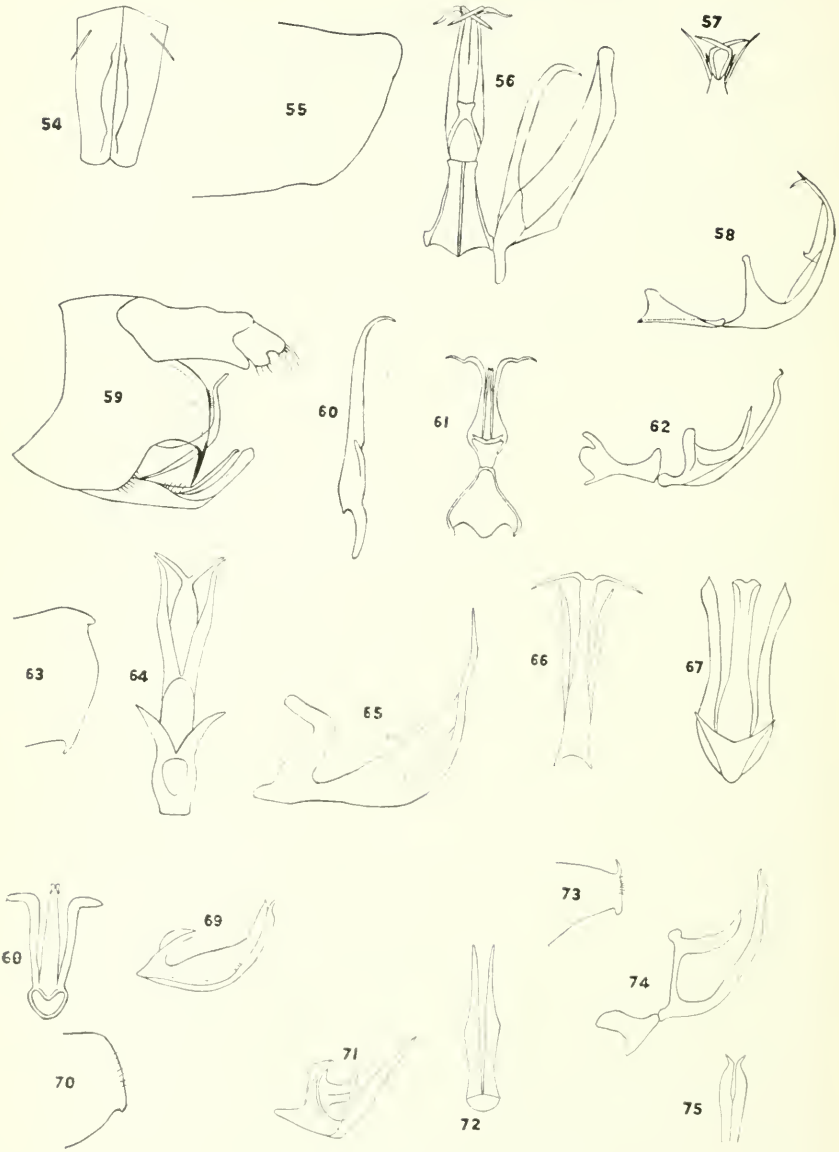

GENITALIA OF TYPHLOCYBA

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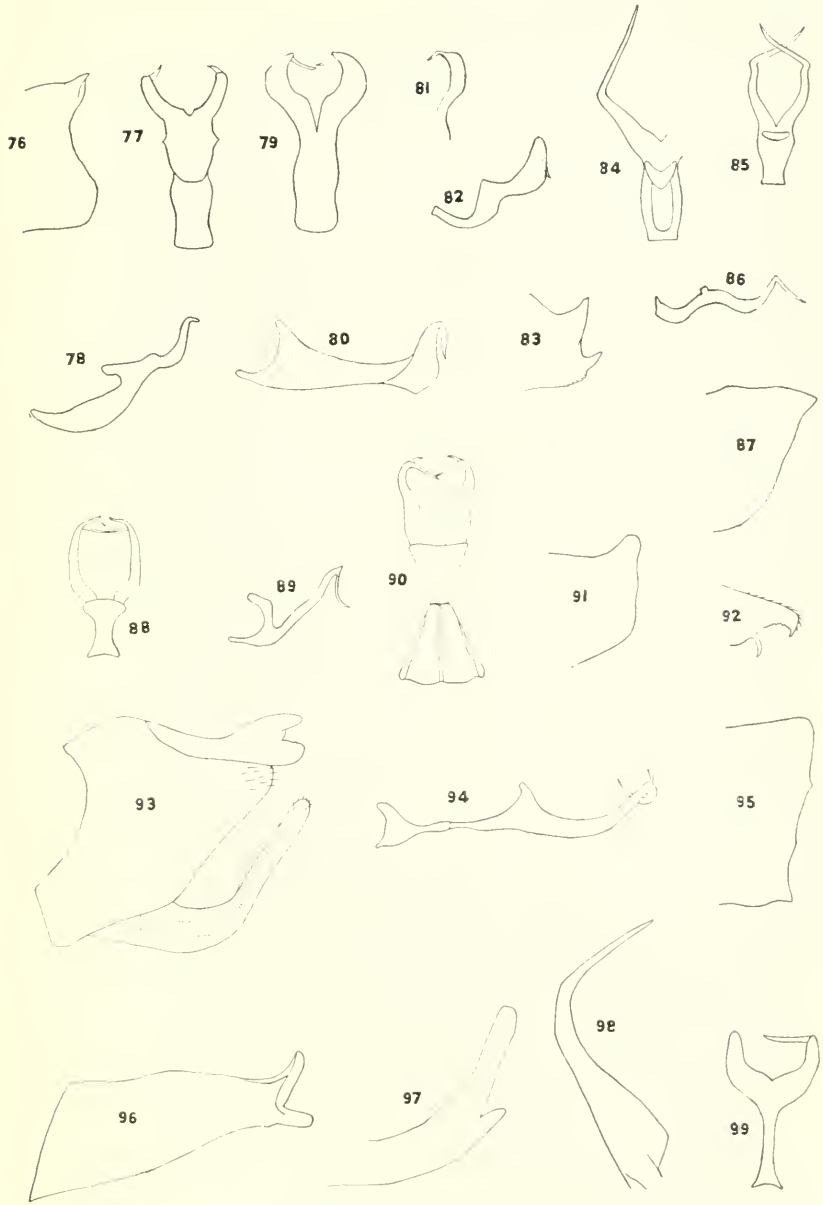

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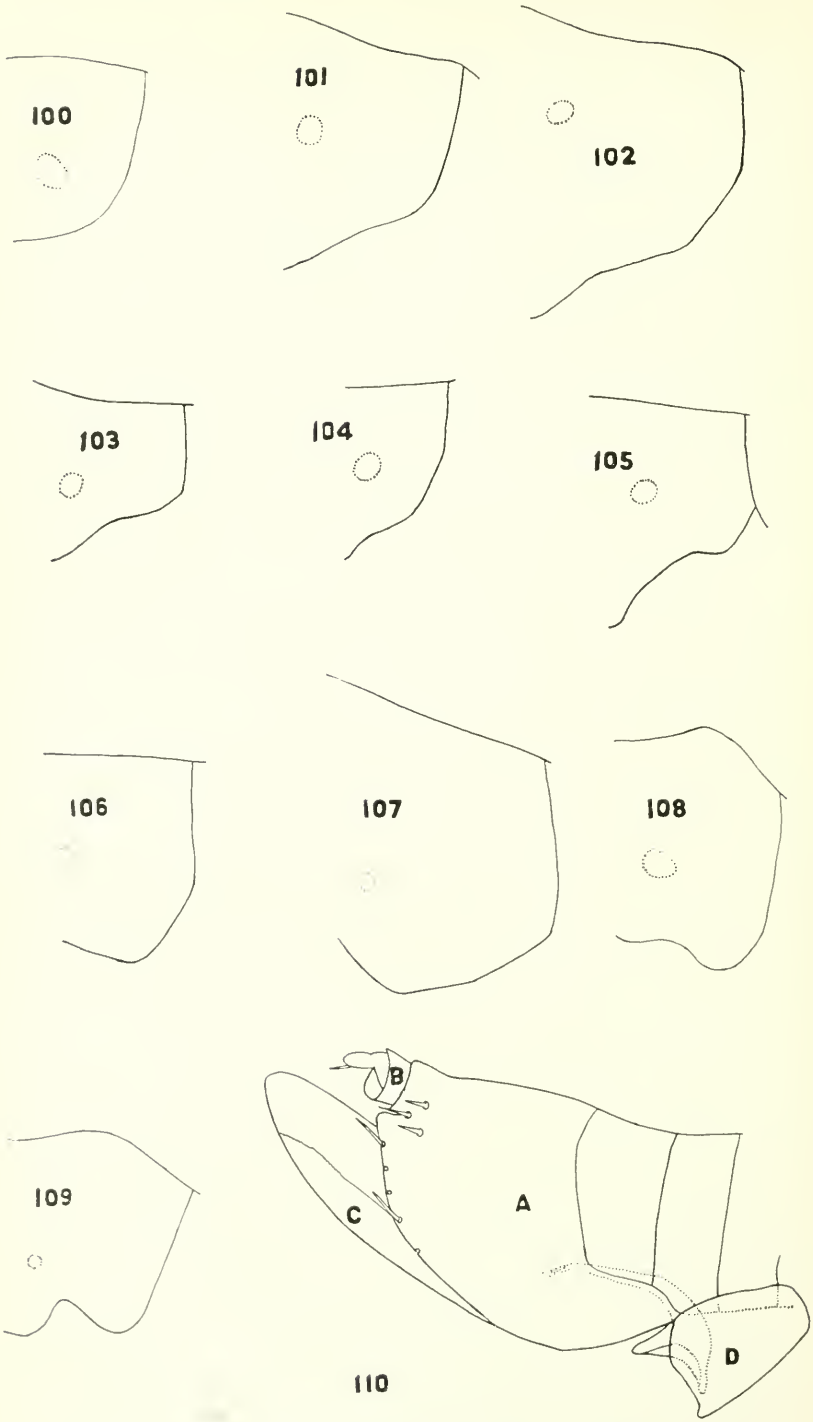

GENITALIA OF TYPHLOCYBA

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A REVISION OF THE AMERICAN LICE OF THE GENUS PEDICULUS, TOGETHER WITH A CONSIDERATION OF THE SIGNIFICANCE OF THEIR GEOGRAPHICAL AND HOST DISTRIBUTION

By H. E. Ewing,

Bureau of Entomology, United States Department of Agriculture

INTRODUCTION

Because the genus *Pediculus* includes lice parasitic on man, it has always been one of great interest and economic importance. Head and body lice not only have the disgusting annoyance caused by their parasitic habits, but they are known to be the transmitters of some serious human diseases such as a typhus and trench fever. From a biological standpoint it is in their variation, geographical distribution, and host relationships that the members of the genus offer their greatest interest, and in this respect they have long furnished an absorbing although puzzling problem to scientists. Almost a century ago entomologists were saying, but by no means proving, that different races of mankind each harbored a different race of *Pediculus*. Since then in each decade at least some one writer has renewed the old assertion and in complete conformity with his predecessors has failed to substantiate it.

When we reflect that it has only been in the last 10 or 15 years that any reliable technique has been employed in the taxonomic study of any of the sucking lice, there is little wonder that the early entomologists with their crude microscopes, or in some cases hand lenses, consistently disagreed with one another in regard to their observations. In the last 10 years methods of clearing, staining, and even dissecting have been developed in connection with the aid of efficient and high-powered microscopes so that now it is possible to ascertain far more accurately small differences which exist among closely related species and varieties. Also time and better transportation facilities have made it possible to enlarge our collections of both hosts and parasites, and thus obtain a better knowledge of their distribution. Because of these new conditions it has appeared to the writer that a revision of the genus *Pediculus* could be made with profit and some expectation of adding stability to the taxonomy and nomenclature of the group. At first it was hoped that a compre-

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hensive treatment of the genus for the whole world could be undertaken, but lack of sufficient material from the Old World made this consideration impossible. After long delay the want of sufficient material even from the New World has made it necessary to reduce decidedly the scope of the present paper.

As already said, the early entomologists held that each of the races of mankind harbored a distinct form of *Pediculus*. It has remained, however, for Fahrenholz (1913, 1915), alone of the living entomologists, actually to demonstrate, in certain instances, according to the viewpoint of the present writer, that there are distinct forms of *Pediculus* for certain racial units of mankind. This German scientist, however, has gone to the extreme of recognizing in one instance as many as three distinct types of *Pediculus* for a single primitive race of man.

It is the intent of the writer not only to review in this paper much of the work of Fahrenholz and others, but to give what he thinks is the proper taxonomic arrangement of the American members of the genus and also to elaborate in more detail some ideas in regard to the significance of host relationship set forth in a preliminary note published in Science (Ewing, 1924).

THE GENUS PEDICULUS LINNAEUS AND THE NAME OF ITS TYPE SPECIES

The genus *Pediculus* was established by Linnaeus in the tenth edition of his Systema Naturae, page 610. His diagnosis follows:

> *Pedes* VI, ambulatorii.
> *Oculi* II.
> *Os* aculeo exserendo.
> *Antennae* longitudine thoracis.
> *Abdomen* depressum sublobatum.

In this genus Linnaeus placed not only the sucking lice of man but a large number of other lice, chiefly from domestic animals. Also he did not at the time of the publication of the tenth edition of his Systema Naturae differentiate between the head louse and the body or clothes louse, including both under his *Pediculus humanus*. In his twelfth edition Linnaeus does differentiate between the head louse and the clothes louse, but he speaks of them as varieties 1 and 2, these designations having no validity according to modern rules of nomenclature. The first one to use varietal names for the two forms of *Pediculus* was De Geer, who in 1778 called the head louse variety *capitis* and the clothes louse variety *corporis*. These are the designations by which both of these forms have been frequently referred to in recent literature, yet, of course, the name *humanus* Linnaeus must have priority over one or the other of them. It should

be added that *corporis* De Geer (1778) has priority over *vestimenti* Nitzsch (1818), a name which is also frequently applied to the clothes louse.

When in 1778 De Geer gave the varietal name *capitis* to the head louse and *corporis* to the body or clothes louse he did not employ the specific name, repeated as a varietal name, to represent either of his varieties—which is required according to modern usage—hence there has been some question as to which varietal name of De Geer should be dropped.

It appears to the writer that the name *humanus* (either varietal or specific) of Linnaeus should be applied to the head louse for two reasons. In the first place it was the variety first described by De Geer in 1778. In the second place, it is the head louse that has long been considered as the genotype of *Pediculus* where the two forms have been regarded as distinct species.

The whole matter is somewhat involved and apparently is not sufficiently covered by our entomological codes of nomenclature or by the International Code of Zoological Nomenclature.

CHARACTERS OF TAXONOMIC VALUE IN THE GENUS PEDICULUS

The characters which have been most used in the past for taxonomic purposes have had to do largely with size, degree of chitinization, ratio of lengths of antennal segments, and chaetotaxy. Undoubtedly such characters have much taxonomic value, but the range of individual variation and the possible effects of hybridization should be taken into consideration at all times.

Mjöberg (1910) used the shape of the genital plate of the female and the form of the gonopods in differentiating his *P. affinis* from *P. consobrinus* Piaget. Fahrenholz (1917) used a large number of characters including size, pigmentation, chaetotaxy, shape of gonopods, shape of antennal segments, etc. Nuttall (1920) pointed out and, according to the view of the present writer, demonstrated that size is such a variable character that its use in taxonomic differentiation should be with much reservation and caution; also, he demonstrated that coloration was so variable a character as to be wholly unreliable for taxonomic purposes. He showed that not only was there great variation between individuals in regard to pigmentation but also that the degree of pigmentation was dependent chiefly on environment, and he further showed that in a single individual certain parts would vary in their pigmentation in a more or less indiscriminate manner. Among the characters that Nuttall (1920) found to be of value are: The shape of the head, the length of the antennae, and the shape of the sixth abdominal segment.

In the course of the writer's study it was found that in specimens properly cleared and mounted the pleural plates offered characters

of fundamental importance for the separation of the different species of the genus. These plates are observed to best advantage from the side, and such a view may be obtained by stripping off the lateral portion of the abdominal wall with a very small and sharp scalpel and mounting this strip separately on a microscope slide; or if specimens are treated with strong caustic and then much of the body contents worked out through a small hole made in the body wall, the walls will collapse when the specimens are mounted, and in doing so will bring the pleural plates into a horizontal position.

In addition to the structures of the pleural plates the writer has found that the chaetotaxy of the thumb of the first pair of legs of

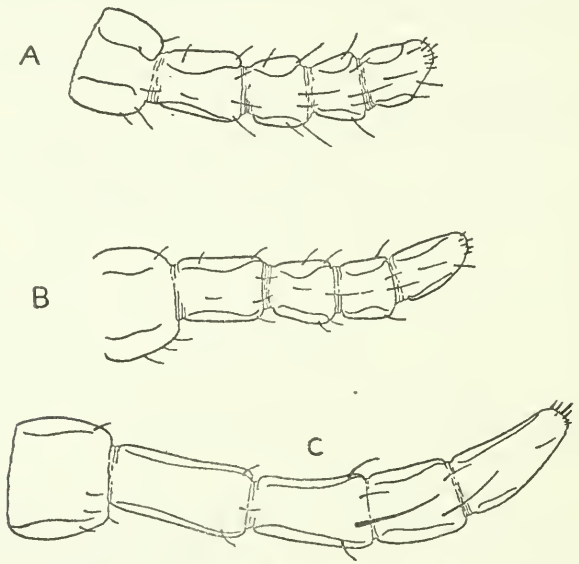

Fig. 1.—The right antenna of female from above of; A, pediculus humanus humanus Linnaeus; B, pediculus humanus americanus, new variety; and, C, pediculus humanus nigritarium Fabricius. (All figures drawn to the same scale.)

the males is of much taxonomic value. The variation in the number of teeth on the claws, particularly the first tarsal claws of the male, has been used by many investigators, but I doubt that it has much real value, particularly in separating the races of lice that are found on man. This belief is in accord with Nuttall's statement (Nuttall, 1920). The number of teeth that can be observed and counted depends largely upon the degree of chitinization, and this in turn depends both on the situation in which the louse has been and the length of time that has elapsed since its last moult.

The ratio which exists between the lengths of the different segments in the antennae and the ratio existing between the length and breadth of each individual segment of the antennae is apparently constant in material which is known to be free from the possible

influence of hybridization. Where such specimens have been examined it has nearly always been possible for the writer to divide those varieties occurring on man into two groups: One in which the antennae are relatively much longer, as in figure 1, C, and in which each segment is relatively much longer in proportion to its width, than in those of the opposite type as shown in figure 1, A and B.

The variation in the size, and to a certain extent in shape, of the thoracic spiracles and the spiracular bulbs (fig. 2) is a character of much importance in separating both species and varieties. In the head louse of Europe these spiracles are almost twice as large as they are in the head louse of American Indian mummies (see fig. 2,

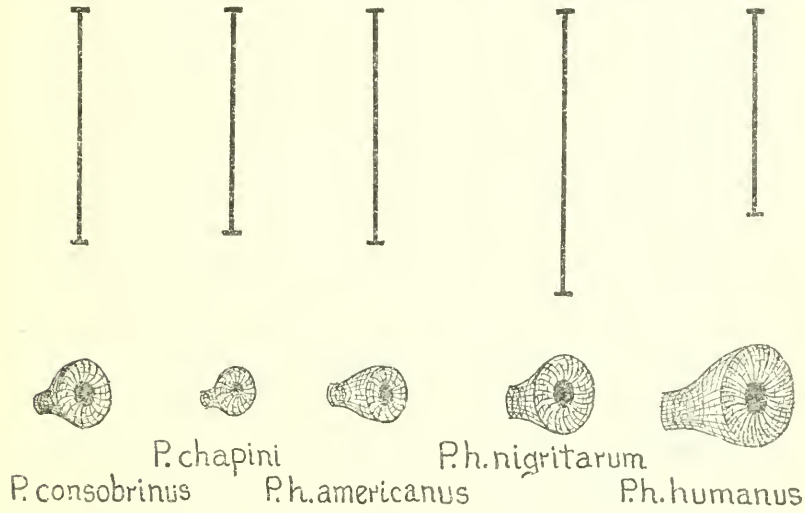

FIG. 2.—DRAWINGS OF THE RIGHT THORACIC SPIRACLE OF A FEMALE LOUSE OF FIVE DIFFERENT KINDS OF PEDICULI. ALL ENLARGED, × 100. THE LINE ABOVE DRAWING OF EACH SPIRACLE REPRESENTS THE LENGTH OF THE LOUSE, × 10

P. humanus humanus and *P. humanus americanus*), yet the European head louse is a smaller louse on the average than that of prehistoric American Indians.

Dorsally, the thorax bears six large setae (macrochaetae), and the relative size of these setae is of great value in certain species. The writer finds that these setae are always present as suggested by Nuttall (1920) and never absent as claimed by Fahrenholz (1916) for one species. However, the variations in the size and positions of these setae are considerable.

Various characters have been used by different investigators and are used to a certain extent in this paper, taking into consideration the range of individual variation and the possible effect of hybridization.

POSSIBLE INBREEDING OF DIFFERENT VARIETIES OR SPECIES

When Bacot (1917) proved that the common head louse of Europe would interbreed with the body louse of that continent and give fertile progeny, he did a most valuable service to taxonomists of the group. After a study of many lice forms collected in this country and after studying the results obtained by others in Europe, the writer is convinced that it has been hybridization that probably more that any other thing has confused different workers in attempting to apply characters that others have claimed should hold good for the lice from a given race of mankind.

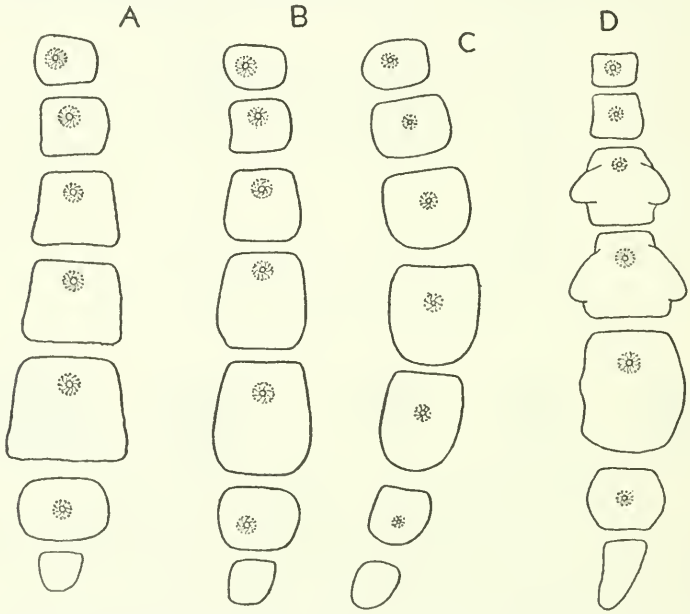

FIG. 3.—LATERAL VIEWS OF THE RIGHT PLEURAL PLATES OF FEMALES OF A, PEDICULUS HUMANUS HUMANUS LINNAEUS, FROM GERMANY; B, P. HUMANUS AMERICANUS, NEW VARIETY, FROM INDIAN MUMMY; C, P. HUMANUS NIGRITARUM FABRICIUS, FROM NEGRO IN AFRICA; D, P. CONSOBRINUS PIAGET, FROM BROWN-HIPPED MARMOSET

In the Americas, in parts of the Orient, and in much of Africa there has long been a mixing on a large scale of some of the primary races of men. Where this has taken place for generations it is observed how easy it would be for the different races of lice to interbreed, if such races did exist and if they could interbreed, as now Bacot has shown that two of such races do.

For this reason in the present work the writer has gone back to mummies in the case of the American Indians to find out what type of louse they harbored before the advent of the white man or the negro in the New World.

Also material was obtained from negroes in Africa and Caucasians in Europe in order to have more assurance that the specimens studied should be really representative of the type belonging naturally to the host race on which they were found. Of course there is no real assurance that in these last two instances the lice obtained were typical for the race on which they were obtained, yet by checking up with various other records it is believed that they are very nearly typical, if no actually so.

Bacot (1917) in his breeding experiments found that some of the characters Mendelized, and, largely because of this fact, concluded that the common head louse and the body louse should be considered as distinct species. An examination of a large series of atypical lice (hybrids) presents various degrees in intergradation, these degrees becoming so fine in certain instances as to simulate a blending of characters.

Genus PEDICULUS Linnaeus

1758 *Pediculus* LINNAEUS (part), Syst. Nat., ed, 10, p. 610.
1842 *Pediculus* DENNY, Mon. Anop., p. 12.
1874 *Pediculus* GIEBEL, Ins. Epizoa, p. 27.
1880 *Pediculus* PIAGET, Les Pédiculines, p. 619.
1904 *Pediculus* ENDERLEIN, Zool. Anz., vol. 28, pp. 136 and 138.
1908 *Pediculus* DALLA TORRE, Gen. Insect., Anop., p. 8.
1910 *Pediculus* MJÖBERG, Ark. f. Zool., vol. 6, no. 13, p. 167.
1916 *Pediculus* FERRIS, Proc. Cal. Acad. Sci., ser. 4, vol. 6, p. 136.
1919 *Pediculus* NUTTALL, Parasitology, vol. 11, p. 334.

The genus *Pediculus* may be described as follows: With the characters of the family Pediculidae, and in addition, antennae distinctly segmented; legs all of the same size; in the male, the first pair of legs modified distally for clasping and in the female the hind femur provided with a posterior tubercle. Eyes conspicuous, pigmented. Abdomen elongate, segmentation marked; no lateral protuberances; pleural plates on all segments except the first. Gonopods of female conspicuous, slightly curved. Not all of the body setae arranged in transverse rows.

KEY TO SUBGENERA OF PEDICULUS

Typical pleural plates with lateral lobes; body setae rather inconspicuous and, setiform, and nearly all of them arranged into transverse rows; thoracic spiracles not conspicuous; chitinous parts usually heavily pigmented. Living on American monkeys.

Subgenus Parapediculus, new subgenus.
(Type species, *P. consobrinus* Piaget)

Typical pleural plates without lateral lobes; body setae conspicuous, frequently peglike and seldom over one-half of them arranged into transverse rows; thoracic spiracles large, conspicuous; chitinous parts frequently poorly pigmented. Living on man.

Subgenus Pediculus Linnaeus.

AMERICAN REPRESENTATIVES OF THE GENUS PEDICULUS LINNAEUS

PARAPEDICULUS, new subgenus

The Pediculi of *Ateles* can, in general, be differentiated by using the same set of characters that are used in separating the varieties occurring on man. The writer recognizes four *Ateles*-infesting species, two of which are here described as new, and all of which may be keyed out as follows:

KEY TO SPECIES OF SUBGENUS PARAPEDICULUS

A.[1] Segment VI of abdomen considerably broader and longer than V; pleural plate V about one and a half times as long as IV

P. (Parapediculus) lobatus Fahrenholz.

A.[2] Segment VI of abdomen not so broad as V and only slightly longer.

B.[1] The inner anterior and single posterior accessory spines of tibial thumb, or protuberance, of legs II and III equidistant from the terminal spine and neither situated in crotch of tibia; pleural plate I very small and not much larger than the inclosed stigmal foramen

P. (Parapediculus) atelophilus, new species.

B.[2] The inner anterior accessory spine of tibial thumb of leg II and III situated almost in crotch of tibia, while posterior accessory spine is situated contiguous with the chief, or terminal, spine; pleural plate I much larger, squarish and over twice the width of inclosed stigmal foramen.

C.[1] Diameter of bulb of thoracic spiracle about 0.09 mm.; posterior accessory spine of tibial thumb II and III much more slender than the inner anterior accessory spine

P. (Parapediculus) consobrinus Piaget.

C.[2] Diameter of bulb of thoracic spiracle about 0.06 mm.; posterior accessory spine of tibial thumb II and III subequal with the inner anterior accessory spine

P. (Parapediculus) chapini, new species.

PEDICULUS (PARAPEDICULUS) LOBATUS Fahrenholz

Plate 2, figure 5

1913 *Pediculus lobatus* Fahrenholz, Zool. Anz., vol. 41, p. 373 (no description).

1917 *Pediculus lobatus* Fahrenholz, Zool. Anz., vol. 48, p. 89.

1919 *Pediculus humanus*, race *capitis* Nuttall, Parasitology, vol. 10, pp. 337, 340.

1920 *Pediculus humanus*, race *capitis* Nuttall, Parasitology, vol. 12, p. 142.

Female.—Head with well-developed neck region; forehead swollen, being broader at about its middle than at its base. Antennae shorter than head. Macrochaetae of thorax unequal, the middle pair longer than the others; machrochaeta I about one-third as long as the width of the first coxa; macrochaeta III situated about the diameter of the bulb of thoracic spiracle behind the same. Abdomen rather short and very broad at the sixth segment, which is much broader than any other segment and almost twice as long as seg-

ment V. Setae of abdomen nearly all arranged in transverse rows, none is peg-like. Pleural plates in the single female observed not sufficiently hardened for description. Legs moderate.

Length of female newly formed and with adhering nymphal skin, 1.83 mm.; width, 0.88 mm.

Male.—Not observed by the writer. Fahrenholz gives only the following sentence in regard to the male in his original description: "♂ mit zweiteiliger Genitalplatte (wie bei P. *capitis maculatus*)."

Length, 1.89–2.19 mm. (Fahrenholz); width, 0.82–0.97 mm. (Fahrenholz).

Type host and type locality.—The host is Schlegel's spider monkey, *Ateles pan.* Type locality?

Type.—Deposition of type not known to writer.

Material examined consists of a single female not yet emerged from her nymphal skin, many nymphs, and eggs. All of these were obtained from a skin (U.S.N.M. 61284) of *Ateles pan*, the monkey having been taken in Guatemala.

This species is very distinct from all the others of its subgenus and genus in the great development of segment VI (see fig. 5, pl. 2), which protrudes conspicuously at the sides of the abdomen far beyond the other segments.

In Fahrenholz's description of *lobatus* he writes that the six large setae (macrochaetae) of the thorax are wanting. Nuttall (1920, p. 148) says that he firmly believes, "that they were merely overlooked by being viewed through balsam." The writer finds that Nuttall is correct in this belief. However, it should be added that the macrochaetae of the thorax in this species are much smaller than they are in *P. humanus.*

PEDICULUS (PARAPEDICULUS) ATELOPHILUS, new species

Figs. 4A and 5

Female.—Unknown.

Male.—Head with neck very distinct; a slight tubercle behind each eye; forehead dome-shaped, being very slightly swollen. Antennae about as long as head; segment I almost twice as broad as long; segment II about one and two-thirds times as long as broad and almost equal to III plus IV; segment III slightly longer than broad and slightly longer than IV; segment IV equally long and broad; segment V about one-third longer than broad and shorter than II. Macrochaetae of thorax almost subequal; macrochaeta I about one-half as long as the width of coxa I; macrochaeta III situated about the diameter of thoracic spiracular bulb behind the same. Posterior marginal setae of thorax rather small, but there are at the lateral extremes of the posterior thoracic margin three larger, subequal setae.

Thoracic spiracles medium, situated dorso-laterally. Abdomen with well marked segmentation; all the larger setae arranged in transverse rows. Pleural plates well chitinized and almost black; pleural plate I (fig. 4,A) small, almost circular, scarcely twice the diameter of the spiracular bulb it contains; pleural plate II squarish, not lobed; pleural plate III smaller than IV but with very distinct lateral lobes; pleural plate IV with large and conspicuous lateral lobes but not so long as V; pleural plate V the longest of all the plates but only slightly lobed laterally; pleural plates VI and VII without lateral lobes. Legs moderate; femur III almost twice as long as broad, tibia III about two and a half times as long as broad.

Length, 2.15 mm.; width, 0.80 mm.

Type host and type locality.—*Ateles geoffroyi* (gray form, or *melanochir* type of coloration); type locality?.

Type.—Cat. No. 28105, U.S.N.M.

This species differs from the others particularly in the characters given in the preceding key. Described from a male specimen taken from the skin of *Ateles geoffroyi* (U.S.N.M. 155393). This *Ateles* skin is from one of several specimens kept some years ago at the National Zoological Park. Three of the skins are marked almost exactly alike (grey type, with black on head, hands, feet, elbows, and knees). The writer has noted infested living specimens of *Ateles geoffroyi* in the National Zoological Park, but has never had the opportunity of examining any of their lice.

In addition to the male specimen mentioned the writer has obtained nits from skins of *Ateles geoffroyi* as follows: From skin (U.S.N.M. 12150), taken at Talamanca, Costa Rica, by W. M. Gabb; from skin (U.S.N.M. 12151) taken at the same place by the same collector; from skin (U.S.N.M. 61209) taken in Costa Rica and from skin (U.S.N.M. 154223) (locality and collector ?).

PEDICULUS (PARAPEDICULUS) CONSOBRINUS Piaget

Plate 1, figs. 1 and 2; text figs. 2 and 3D

1880 *Pediculus consobrinus* PIAGET, Les Pediculines, p. 626, pl. 51, fig. 4.
1908 *Pediculus consobrinus* DALLA TORRE, Gen. Ins., Anop., p. 8.
1910 *Pediculus affinis* MJÖBERG, Ark. f. Zool., vol. 6, no. 13, p. 169, fig. 85.
1911 *Pediculus consobrinus* NEUMANN, Arch. Par., vol. 14, p. 412.
1913 *Pediculus consobrinus* FAHRENHOLZ, Zool. Anz., vol. 41, p. 372.
1916 *Pediculus mjöbergi* FERRIS, Proc. Cal. Acad. Sci., ser. 4, vol. 6, p. 136.
1919 *Pediculus humanus* NUTTALL (in part), Parasitology, vol. 11, p. 334.

Female.—Head rather short; neck scarcely differentiated and poorly chitinized, the ocular plates stopping abruptly and bearing a low tubercle at their posterior margins; forehead short, about twice as broad as long. Antennae about equal to the head in length;

segment I almost twice as broad as long; segment II about one and a third times as long as broad and but slightly longer than III; segment III longer than broad and longer than IV; segment IV scarcely as long as broad; segment V short, only slightly longer than broad. Macrochaetae of thorax medium, I and II subequal, III slightly smaller; macrochaeta I slightly longer than the width of coxae I; macrochaeta III situated about the diameter of bulb of thoracic spiracle behind the same. Posterior marginal setae of thorax, 7–9 on each side, including a larger submedian pair and

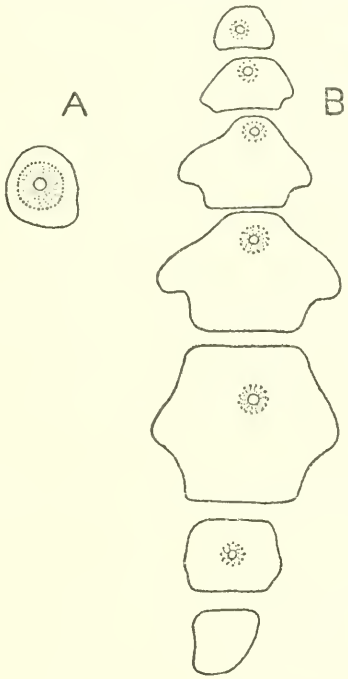

FIG. 4.—A, LATERAL VIEW OF FIRST PLEURAL PLATE OF RIGHT SIDE OF MALE OF PEDICULUS (PARAPEDICULUS) ATELOPHILUS, NEW SERIES; B, LATERAL VIEW OF RIGHT PLEURAL PLATES OF FEMALE OF PEDICULUS (PARAPEDICULUS) CHAPINI, NEW SPECIES

three larger, subequal setae near the corner of thorax. Thoracic spiracles rather small, diameter of bulb 0.089 mm., more dorsal than lateral in position. Abdomen large; segment VI longer than V but not so broad; all the abdominal setae except the minute hairs arranged strictly in transverse rows; transverse row on ventral surface of segment VI with 10–11 setae which extend scarcely half way to posterior margin of segment, flanking pair of setae slightly larger than those in row, discal setae few, minute hairs. Pleural plates (fig. 3, D) large, conspicuous; pleural plate I squarish, over twice as long as diameter of stigmatic bulb; plate II squarish, about as broad as I but much longer; plate III very much larger than II

and with large, conspicuous lateral lobes; plate IV larger than III and with larger lateral lobes; plate V much the largest of all the pleural plates, with or without very small lateral lobes; plate VI broader than long and without lateral lobes; plate VII triangular, longer than broad. Legs of medium length; femur I only slightly longer than broad; tibia I over twice as long as broad. Posterior tubercle of femur III large, with a deep emargination next to it on the inside, bearing a seta near tip longer than tubercle itself.

Length of an average-sized, unengorged female, 3.15 mm.; greatest width, 1.30 mm.

Male.—Leg I slightly enlarged; femur I slightly longer and tibia I slightly shorter than in the female; tarsus I enlarged. Setae on anterior tibial thumb as follows: Chief or distal spine extending beyond the margin of thumb by half its length; dorsal accessory spine about half as thick as distal one, of the same length, and situated less than its own width inside of terminal spine; outer ventral accessory spine setiform, twice as long as the terminal spine and situated directly below it; inner ventral accessory spine slightly longer than terminal spine and about one-half as broad, situated considerably inside the other accessory spines but not in the crotch of the tibia. Pleural plates similar to those of female except for I and III; I is irregular in shape and much broader than long, III has low, small lateral lobes instead of the conspicuous ones found in the female.

Length of average-sized specimen, 2.45 mm.; greatest width, 0.90 mm.

Type host and type locality.—Ateles paniscus from (?).

Described from very many specimens of both sexes taken from "post-mortem" specimen of host species, *Ateles paniscus* (U.S.N.M. 238254), collected at Beni, Bolivia.

In 1922 Dr. W. M. Mann brought back with him from South America two red-faced spider monkeys (*A. paniscus*) that were grossly infested with *P. consobrinus*. The monkeys were presented to the National Zoological Park, but within a few days one of them died. This specimen was "pickled" in a large jar where the writer observed that it was loaded with thousands of lice in all stages of development, and the hairs of the host in all parts of its anatomy contained countless numbers of nits. The other individual received several treatments for lice at the zoological park but died within a few weeks.

Doctor Mann also brought back with him two living examples of the brown-hipped marmoset (*Lenotocebus nigricollis*), obtained at Tumupasa, Bolivia. These were placed in the National Zoological Park, but lived only a few days. When they died they showed a slight infestation with a *Pediculus*, species, and nits in some abun-

dance were present. These Pediculids appear to agree in all respects with those from *Ateles paniscus*, hence the writer is of the opinion that the lice represented stragglers on the marmosets notwithstanding they had lived for some days on this peculiar host.

Mjöberg (1910) described as new his *Pediculus affinis* from an undetermined species of *Ateles*. Later (1916) Ferris gave a new name to this louse, that of *mjöbergi*, since *affinis* was preoccupied. When the present writer compared the specimens of pediculi from *Ateles paniscus* with Piaget's description and figures considerable disagreement was found. When compared with Mjöberg's description and figure almost perfect agreement was noted. Both Piaget and Mjöberg give a detailed drawing of the ventral side of the last segments of the female, showing the genital plate and gonopods. I find that in the specimens I have studied the genital plate and the gonopods are as Mjöberg figures them, as is shown on photograph (pl. 1, fig. 2). Not only this but the smaller differences mentioned

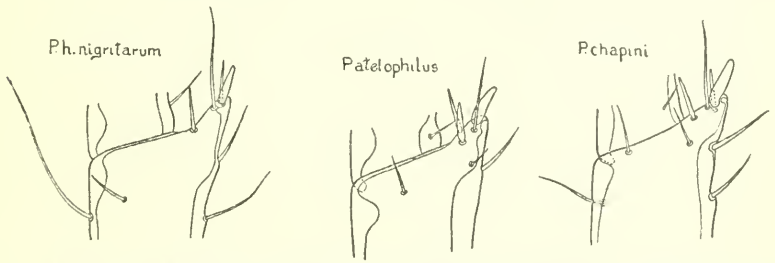

FIG. 5.—ANTERIOR VIEW OF DISTAL END OF LEFT HIND TIBIA OF MALES OF THREE SPECIES OF PEDICULUS, ALL DRAWN TO THE SAME SCALE

by Mjöberg between his *affinis* and Piaget's *consobrinus* I find do not hold when specimens from the type host of *consobrinus* are examined. It appears that the drawing given of the genital plate and gonopods by Piaget were made from a specimen that was somewhat shriveled (as most balsam mounts are). This would particularly account for the strongly-curved, sharp-pointed gonopods as figured by Piaget. I do not believe that gonopods of such a shape exist anywhere in the genus *Pediculus*.

This large louse is very typical of the subgenus *Parapediculus*, and quite different from the head louse of man as noted by Piaget, Mjöberg, and others.

PEDICULUS (PARAPEDICULUS) CHAPINI, new species

Plate 1, figs. 3 and 4; text figs. 2, 4B, 5

Female.—Head with poorly developed neck region; postocular tubercle rather pronounced; forehead about twice as broad as long, slightly swollen. Antennae about as long as head; segment I almost twice as wide as long; segment II about one and a half times as long

as broad; segment III distinctly longer than broad and longer than IV; segment IV about as broad as long; segment V only slightly longer than broad and equal to III in length. Macrochaetae of thorax medium, subequal; macrochaeta I about two-thirds as long as the width of coxa I; macrochaeta III situated slightly more than the diameter of the bulb of thoracic spiracle behind the same. Posterior marginal setae of thorax about 6 or 7 on each side, a larger pair near the median plane and three large pairs situated laterally. Thoracic spiracles the smallest of any species of the genus observed by the writer, being 0.062 mm. in diameter across the bulb. Abdomen large and long, segment VI slightly longer and slightly narrower than V. Body setae small and hard to see, all the larger ones arranged in transverse rows. Number of setae in transverse row on ventral side of segment VI typically 10. Pleural plates (fig. 4, B) very long and very broad; pleural plate I broader than long and slightly lobed laterally; plate II very broad, distinctly lobed laterally and with spiracle almost touching the anterior margin; plate III much longer than II and much more strongly lobed; plate IV larger than III but of the same shape; plate V the largest of all the pleural plates and distinctly lobed laterally; plate VI small, broader than long, and slightly lobed laterally; plate VII somewhat triangular, slightly longer than broad. Legs medium; femur I longer than broad; tibia I about twice as long as broad. Tubercle of femur III large, with a deep notch in margin of leg next to it, bearing on anterior side some distance from tip a seta shorter than tubercle itself.

Length of an average-sized, unengorged female, 2.95 mm.; greatest width, 1.35 mm.

Male.—Leg I about the same length as the others but with the tibia shorter and stouter and the tarsus slightly enlarged. Distal, or chief, spine of thumb of tibia I extending beyond the margin of thumb by a little over one-half its length; outer anterior accessory spine very sharp, about one-half as broad as the distal spine and as long as the same; inner anteror accessory spine subequal with outer anterior accessory spine and situated almost in the crotch of the tibia; ventral or posterior accessory spine long, setiform, about twice as long as the distal spine. Pleural plates smaller but similar to those of female, the first one somewhat differently shaped from the first plate of the female, being broader in proportion to its length and more irregular.

Length of average-sized specimen, 2.45 mm.; width, 0.95 mm.

Type host and type locality.—*Ateles ater*, from?

Type slide.—Cat. No. 28106, U.S.N.M.

Described from many males and females taken by Dr. E. A. Chapin from an individual of *Ateles ater* which died in the National

Zoological Park in 1921. Nits were taken from skin (U.S.N.M. 200153) of *Ateles ater* and also from skin of young male of *Ateles ater* from Brazil which died in Washington, July 24, 1915.

This species is closely related to *P.* (*Parapediculus*) *consobrinus* Piaget, but differs from Piaget's species in having a much smaller thoracic spiracle, pleural plates smaller, more strongly lobed, and of a different shape (see figs. 3, D and 4, B), particularly is this true of pleural plates II and V.

Subgenus PEDICULUS LINNAEUS

In America it is difficult to obtain representatives of man-infesting pediculi that are typical of the different forms which originally inhabited the different races of men. This has caused the present writer much inconvenience in revising the genus for the New World, but it may be that as a result of this inconvenience and its attendant delay a much better conception and a much more accurate knowledge have been obtained in regard to the lice types of mankind. All forms occurring on man are here regarded as varieties of the Linnaean species, *Pediculus humanus*. This is done largely because the writer has been unable to determine just what type of louse is represented by the *corporis* of De Geer. Undoubtedly many of the body lice of America and Europe are hybrids between the Caucasian head louse of man and some other type of head or body louse.

The five varieties of *Pediculus humanus* which the writer can recognize in our American fauna are keyed out as follows:

A.[1] Over one-half of the body setae arranged into definite transverse rows, those that are not so arranged chiefly setiform; number of setae in ventral row on segment VI of female typically 8; diameter of bulb of thoracic spiracle less than a tenth of a millimeter; macrochaetae of thorax shorter.

B.[1] Second and fifth antennal segments each twice as long as broad and segment III broadened distally and distinctly longer than IV.

C.[1] Second pair of macrochaetae of thorax longer than the others; macrochaeta III of thorax situated about the diameter of the thoracic spiracle behind the same

P. (Pediculus) humanus nigritarum Fabricius.

P. (Pediculus) humanus corporis De Geer.

C.[2] Second pair of macrochaetae of thorax subequal with others; macrochaeta III of thorax situated more than the diameter of thoracic spiracle behind the same

P. (Pediculus) humanus marginatus Fahrenholz.

B.[2] Second and fifth antennal segments each about one and a half times as long as broad and segment III subequal or almost subequal with IV_____ **P. (Pediculus) humanus americanus**, new variety.

A.[2] Scarcely half of the body setae arranged into definite transverse rows, those that are not so arranged are spinelike or peglike; number of setae in ventral row on segment VI of female typically 12 (11 to 13); diameter of spiracle bulb considerably over a tenth of a millimeter

P. (Pediculus) humanus humanus Linnaeus.

PEDICULUS (PEDICULUS) HUMANUS NIGRITARUM Fabricius

Plate 2, figs. 6 and 7; text figs. 1c, 2, 3c, 5, 6

1805 *Pediculus nigritarum* FABRICIUS, Systema Antliatorum, p. 340.

1816 *Pediculus nigrescens* OLFERS, De vegetativis et animatis corporibus in corporibus animcatis reperiundis commentarius. Pars I, p. 81. Berlin (Reference from Fahrenholz, work not seen by writer).

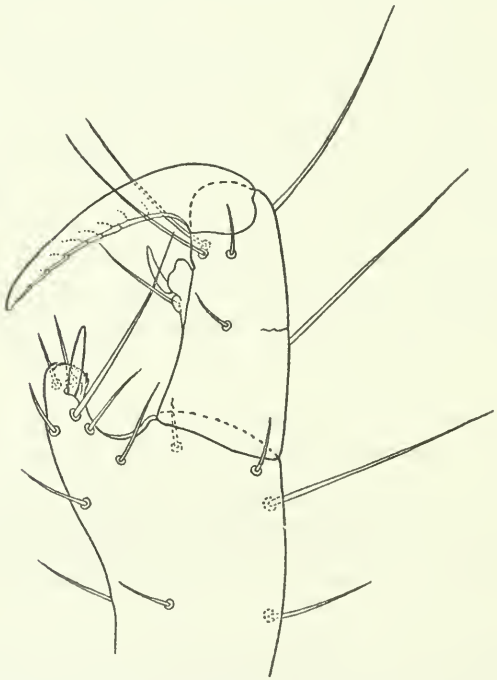

FIG. 6.—VENTRAL VIEW OF END OF LEFT ANTERIOR LEG OF MALE OF PEDICULUS (PEDICULUS) HUMANUS NIGRITARUM FABRICIUS

Female.—Head about as broad as long; forehead about twice as broad as long, not swollen; eyes less conspicuous than in most forms of *Pediculus;* postocular tubercle reduced. Antennae equal to or slightly surpassing the head in length; segment I frequently as long as or longer than broad; segment II twice as long as broad but not as long as III plus IV; segment III decidedly broadened distally and about one and a half times as long as broad; segment IV scarcely at all broadened distally, slightly longer than broad and shorter than III; segment V about twice as long as its width at the base and equal in length to segment II. Macrochaetae of thorax

medium in length, II slightly longer than I and III; macrochaeta I about two-fifths as long as width of coxa I; macrochaeta III about the diameter of thoracic spiracle behind the same. Posterior marginal setae of thorax typically six on each side, all spinelike but the outer one and the third from the outer end of row very minute. Thoracic spiracles medium, spiracular bulb 0.110 mm. in diameter. Abdomen very large and in case of some females much distended by developing egg; most of abdominal setae in transverse rows, the dorsal ones two or three times as long as the ventral ones; setae in transverse row on ventral side of sixth abdominal segment typically 8 but varying from 7 to 9. Pleural plates usually rather poorly chitinized and poorly pigmented; plate I broader than long and not squarish; plate II broader than long and squarish, spiracle situated slightly in front of the middle; plate III about equal in length and breadth, spiracle slightly in front of middle; plate IV the largest of all the pleural plates, longer than broad and slightly broader than III; plate V as long as IV but not so broad; plate VI small, spiracle behind the middle; plate VII almost circular, but varying much in shape. Legs slender; femur I about one and a half times as long as broad; tibia I about two and a half times as long as broad. Tubercle of femur III varying in size, low, usually only a slight notch in leg inside of tubercle, seta on tubercle about twice as long as tubercle itself.

Length of an average-sized, unengorged female, 3.80 mm.; greatest width, 1.40 mm.

Male.—Leg I stouter than in female with thumb much larger; tibia I about twice as long as broad; distal, or chief, spine of thumb of tibia I not extending beyond the margin of the thumb by half its length; outer, anterior accessory spine setiform, almost three times as long as the terminal spine itself; inner anterior accessory spine rather slender and slightly longer than the terminal spine; posterior accessory spine almost setiform, being much smaller but about as long as the inner anterior accessory spine. Chaetotaxy of distal end of left hind tibia (fig. 5) as follows: Distal, or chief, spine extending beyond the tip of margin of process by about three-fourths its length; outer, anterior accessory spine about two and a half times as long as distal spine; inner, anterior accessory spine about as long as distal spine and situated in crotch of tibia; posterior accessory spine longer than distal spine and about as stout as the inner, anterior accessory spine. Pleural plates not essentially different from those of the female, plate I appears to be a little more irregular in shape and somewhat smaller than in the female.

Length, 3.00 mm.; width, 1.05 mm.

Type host and type locality.—African negro, in Africa (?).

This description is based on females and males collected from negroes in Africa by H. C. Raven of the Smithsonian-Universal African Expedition of 1919–1920. Of the American specimens of *Pediculus* examined by the writer those of a lot taken by R. H. Hutchinson at New Orleans, Louisiana, May 1, 1918, should be referred to this variety. I find them almost identical with the material taken from negroes in Africa. Most of the body lice found in North America appear to be impure races or hybrids.

PEDICULUS (PEDICULUS) HUMANUS CORPORUS De Geer

1758 *Pediculus humanus* LINNAEUS (part), Syst. Nat., ed. 10, p. 610.
1766 *Pediculus humanus*, variety *2* LINNAEUS, Syst. Nat., ed. 12, vol. 2, p. 1016.
1778 *Pediculus humanus*, variety *corporis* DE GEER, Mem. Hist. Ins., vol. 7, p. 67, pl. I, fig. 7.
1818 *Pediculus vestimenti* NITZSCH, Germar's Mag., vol. 3, p. 305.
1842 *Pediculus vestimenti* DENNY, Mon. Anop., p. 16, pl. 26, fig. 1.
1874 *Pediculus vestimenti* GIEBEL, Ins. Epizoa, p. 27, pl. 1, fig. 5.
1880 *Pediculus vestimenti* PIAGET, Les Ped., p. 623, pl. 50, fig. 3.
1908 *Pediculus corporis* DALLA TORRE, Gen. Ins., Anop., p. 8.
1910 *Pediculus vestimenti* MJÖBERG, Ark. f. Zool., vol. 6, no. 13, p. 168.
1911 *Pediculus capitis*, variety *vestimenti* NEUMANN, Arch. de Par., vol. 14, p. 411.
1912 *Pediculus corporis* FAHRENHOLZ, 2–3–4th Jahresb. d. Niedersäch. Zool. Ver., p. 2, fig. 2, pl. 3, figs. 1–2.
1913 *Pediculus corporis* FAHRENHOLZ, Zool. Anz., vol. 41, p. 373.
1916 *Pediculus corporis* FERRIS, Proc. Cal. Acad. Sci., ser. 4, vol. 6, p. 137.
1917 *Pediculus humanus* (*vestimenti*) BACOT, Parasitology, vol. 9, p. 255.
1919 *Pediculus humanus*, race *corporis* NUTTALL, Parasitology, vol. 11, p. 334.
1920 *Pediculus humanus*, race *corporis* NUTTALL (part), Parasitology, vol. 12, p. 151.

No attempt is here made to describe the body louse of Europe or of the Caucasian race. Up to the present the writer has been unable to get material which could be considered as truly representative of the form described by Linnaeus and by De Geer and other early entomologists. Indeed, if such forms were available for study there would probably be but little assurance that they were free from hybridization. That the ancient Mediterranean peoples had contacts with negroes and, in the case of the Egyptians, had many negro slaves is well known. Theoretically, at least, there should have been no reason why the body louse of the negro should not have spread to the Hebrews, Greeks, Phoenicians, and others.

De Geer (1778) figures his *P. humanus corporis* as being very much like his *P. humanus capitis*, so much so in fact that one is inclined to wonder if he really had the typical European body louse or one of the hybrids from the head louse of that continent. A

closer inspection of his figures (pl. I, T. VII) shows that his variety *capitis* has the abdominal segments more clearly demarcated, the pleural plates pigmented, the neck region more distinct and the thorax flatter than in his variety *corporis*. Although these characters are quite variable and not strictly reliable for separating most of the body lice that are found on white people from the typical European head louse, yet they do indicate that what he was dealing with was a variety very similar in certain respects to the forms mentioned by others as the body louse of Europeans.

Some of the American body lice are similar to the head louse of Europe, others are similar to the Indian head-louse type, and yet others show affinities with the body louse of Africa. In these forms there are found almost all degrees of intermediate characters, be they the shape of antennal segments, shape of neck region, chaetotaxy, size of thoracic spiracle, or any one of several other structures.

Judging from the literature and from observations on many body louse hybrids, the *corporis* of De Geer was a smaller louse than *P. humanus nigritarum*, and also it had the discal setae of the abdomen more numerous and more peglike; the segments of the antennae were hardly as long and were of more uniform width.

It is highly probable that a race of *P. humanus capitis* spread to the body from the head as the habit of wearing clothes developed among the Caucasians. It is stated that some races of man when they were yet uncivilized had no body lice, but when a certain amount of clothes-wearing was practiced and contacts with white man were made they became infested with body lice in addition to the head lice.

PEDICULUS (PEDICULUS) HUMANUS ANGUSTUS Fahrenholz

1915 *Pediculus capitis angustus* FAHRENHOLZ, Zeit. f. Morph. u. Anthro., vol. 17, p. 597.

1915 *Pediculus capitis marginatus* FAHRENHOLZ, Zeit. f. Morph. u. Anthro., vol. 17, p. 599.

1917 *Pericultus humanus marginatus* FAHRENHOLZ, Zool. Anz., vol. 48, p. 87.

1917 *Pediculus humanus chinensis* FAHRENHOLZ, Zool. Anz., vol. 48, p. 87.

1917 *Pediculus corporis angustus* FAHRENHOLZ, Zool. Anz., vol. 48, p. 88.

1919 *Pediculus humanus*, race *capitis* NUTTALL (part), Parasitology, vol. 11, p. 334.

1920 *Pediculus humanus*, race *capitis* NUTTALL (part), Parasitology, vol. 12, p. 152.

Female.—Only hybrid or racially impure females observed.

Male.—Head longer than broad, yet with poorly developed neck; forehead long, two-thirds as long as broad and with sides much more heavily chitinized than the temples; postocular tubercles low. Antennae (broken in two specimens observed and last two segments wanting) of the type of *corporis*; first segment slightly broader than long and broadest at its base; second segment twice as long as broad and broadened distally; third segment one and a half times as long

as broad. Macrochaetae of thorax subequal, macrochaeta I equal to about one-half of the width of coxa I; macrochaeta III more than the diameter of thoracic spiracle behind the same. Posterior marginal setae of thorax typically eight on each side, the two nearest the median line and the two nearest the lateral margin of the body much larger than the others. Thoracic spiracles medium sized, diameter of bulb 0.091 mm. Abdomen of typical shape for the genus; setae varying much in size, nearly all of them in transverse rows and but few of them spinelike, or peglike. Pleural plates similar to those of *corporis* or *americanus*; plate I about twice as broad as long. Legs long; femur I twice as long as broad; thumb of tibia I very long, being almost as long as the tibia itself. Chaetotaxy of thumb of tibia I: Chief spine swollen about its middle and attenuated distally, extending beyond the margin by almost exactly one-half its length; anterior accessory spine very slender and situated more on the inner than the anterior margin of the thumb; outer posterior accessory spine a long seta over twice as long as the chief spine; inner posterior spine very slender, setiform and situated inside of the anterior accessory spine.

Length, 3.40 mm.; greatest width, 1.25 mm.

Type host and type locality.—Japanese race. Type locality (?)

This description is based upon two males taken at Shuin Gien Su (elevation, 1,200 feet), south of Suifu, Szechuan, China (probably from a Chinaman), May 10, 1924, collected by D. C. Graham.

The most characteristic thing about this variety (according to characters of two specimens examined) is the small size of the accessory spines on the thumb of tibia I and the rather extreme length of segments II and III of the antennae. This louse probably infests the head chiefly, but to a certain extent the body also. It has not been shown in the case of the yellow race of mankind or the red race that a distinctive body louse developed apart from the type found on the head.

Undoubtedly the Chinese race of *Pediculus humanus* has been brought to America with the influx of Orientals. The nearest approach to an authentic record for this variety from America which the writer has obtained is a lot of 2 females and 1 male taken by Dr. L. Stejneger (No. 1743) in 1882 from an Aleutian Eskimo at Bering Island. These lice appear to be hybrids.

PEDICULUS (PEDICULUS) HUMANUS AMERICANUS, new variety

Plate 3, figs. 9, 10, 11; text figs. 1B, 2, 3B

Female.—Head with very poorly developed neck region; forehead by no means twice as broad as long; postocular tubercle low. Antennae medium in length and not as long as head; segment I almost twice as broad as long; segment II almost one and a half

times as long as broad; segment III as broad as long and longer than IV; segment IV broader than long; segment V about one and a half times as long as broad; segments II, III and IV broadest at distal ends. Macrochaetae of thorax moderate; second pair slightly longer than the other two; macrochaeta I slightly less than one-half as long as the width of coxa I; macrochaeta III situated about the diameter of thoracic spiracle behind the same. Thoracic spiracles rather small, diameter of spiracular bulb 0.080 mm. Abdomen with sharp divisions between segments; about half of the setae of abdomen are arranged in transverse rows, those that are not in rows are smaller; number of setae in transverse row on ventral side of sixth abdominal segment from 7 to 9, average 8 (of 10 females examined 8 had 8 setae in this row). Pleural plates similar to those of *humanus humanus* but less squarish, although there is much variation in their shape. Legs medium in length and stoutness; femur I about one and a third times as long as broad; tibia I fully twice as long as broad. Tubercle on femur III large, its seta not as long as the tubercle itself. In *americanus* there is a tendency for all the femora to have a posterior tubercle, but those on femora I and II are never conspicuous like the tubercle on femur III.

Length of average sized, unengorged female, 3.15 mm.; greatest width, 1.00 mm.

Male.—Leg I stouter than in female. Thumb of tibia I with spines as follows: Chief spine extending less than one-half its length beyond the margin of the thumb; anterior accessory spine situated but slightly nearer the inner than the outer margin of thumb and not extending beyond the margin; outer posterior accessory spine long, somewhat setiform, and situated as near the outer margin of the thumb as the chief spine itself; inner posterior spine large, about two-thirds as broad as chief spine but longer and situated back from the inner margin of the thumb. Pleural plates similar to those of female, plate I usually somewhat smaller and broader in proportion to its length. Femur III showing a slight tubercular swelling on posterior margin.

Length, 2.65 mm.; greatest width, 0.80 mm.

Type host and type locality.—American Indian mummy from Surco, Peru.

Type (paratype).—Cat. No. 28107, U.S.N.M.

Described from males and females taken from the scalps of American Indian mummies loaned by the American Museum of Natural History through the courtesy of Dr. Frank E. Lutz. Holotype (a female, deposited in American Museum of Natural History) taken from hair of head of mummy $\frac{B}{1342}$, Surco, Peru; nymphs and nits

also were obtained from same hair sample. Other mummy lice material examined as follows: Abdomen of female and first nymphal instar (dissected from nit) taken from mummy B–4710, Ancon, Peru; 5 males, 11 females and numerous nymphs in various stages of development, as well as nits from mummy $\frac{G}{404}$, Canyon del Muerto, New Mexico. Also nits were obtained from the following hair samples from the heads of Indian mummies from the American Museum of Natural History $\frac{41.0}{3395}$, $\frac{B}{4558}$, $\frac{B}{4695}$, $\frac{B}{4703}$, 707, $\frac{G}{401}$, and $\frac{G}{558}$.

As previously mentioned (Ewing, 1924), the lice from Peruvian Indian mummies were found to be "slightly different" from those of the mummies from the southwestern part of the United States. Those from Peru are slightly suggestive of the *corporis* form in the segmentation of the antennae, there being a rather noticable distal enlargement of segments II, III, and IV. Also all the ventral setae of the Peruvian lice are more peglike than those of the New Mexico type, this being particularly true of the ventro-lateral pair of segment VI.

To this variety should be referred a lot of 4 males and 3 females and 1 nymph taken from an Indian woman at Coban, Guatemala, (Bishopp 10403) and a lot consisting of 1 female, 3 males, and 1 male nymph taken on the island of Trinidad, race of host unknown. These lice from Trinidad are slightly smaller, on the average, than those taken from the Indian mummies, but they agree with the mummy lice in essential characters. A lot of lice from a Greenland Eskimo and another from an Aleutian Eskimo, or probably more correctly an Aleutian mixed breed, *do not* belong to the variety *americanus*.

PEDICULUS (PEDICULUS) HUMANUS HUMANUS Linnaeus.

Plate 3, fig. 8; text figs. 1A, 2, 3A, 7

1758 *Pediculus humanus* LINNAEUS (part), Syst. Nat., ed. 10, p. 610.
1766 *Pediculus humanus*, variety *I* LINNAEUS, Syst. Nat., ed. 12, vol. 2, p. 1016.
1778 *Pediculus humanus*, variety *capitis* DE GEER, Mem. Hist. Ins., vol. 7, p. 67, pl. 1, fig. 6.
1817 *Pediculus cervinlis* LEACH, Zool. Misc., vol. 3, p. 66.
1818 *Pediculus capitis* NITZSCH, Germar's Mag., vol. 3, p. 305.
1842 *Pediculus capitis* DENNY, Mon. Anop., p. 13, pl. 26, fig. 2.
1874 *Pediculus capitis* GIEBEL, Ins. Epizoa, p. 30, pl. 1, figs. 1–2.
1880 *Pediculus capitis* PIAGET, Les Ped., p. 619, pl. 51, fig. 2.
1908 *Pediculus capitis* DALLA TORRE, Anoplura Gen. Ins., p. 8, pl. figs. 1*a* and 1*b*.
1910 *Pediculus capitis* MJÖBERG (part), Ark. f. Zool., vol. 6, no. 13, p. 168.

1912 *Pediculus capitis* FAHRENHOLZ, Jahresb. d. Niedersach. Zool. Ver., p. 2, figs. 1, 3, 7, pl. 3, figs. 3–4.
1916 *Pediculus capitis* FERRIS, Proc. Cal. Acad. Sci., ser. 4, vol. 6, p. 136.
1919 *Pediculus humanus*, race *capitis* NUTTALL (part), Parasitology, vol. 11, p. 334.
1920 *Pediculus humanus*, race *capitis* NUTTALL (part), Parasitology, vol. 20, p. 152.

Female.—Head with well-developed, poorly chitinized neck region; forehead about as broad as long; postocular tubercles well chitinized and with stiff spinelike setae. Antennae considerably shorter than the head; first segment about twice as broad as long; second segment about one and a half times as long as broad; third segment slightly longer than broad; fourth segment of equal length and breadth; fifth segment about one and a half times as long as broad. Macrochaetae of thorax not equal, the second pair being longer than the others; macrochaeta I about one-half as long as the width of coxa I; macrochaeta III situated less than the diameter of the thoracic spiracle (bulb of spiracle) behind the same. Posterior marginal setae of thorax about fourteen in number on each side; not far from the median line are two pairs of these setae, one pair above the other, which are larger than the others. Thoracic spiracles the largest of any variety of *P. humanus*, being 0.134 mm. in diameter (across the bulb). Abdomen long and rather slender; setae, almost without exception, spinelike or peglike and most of them are not arranged in transverse rows; ventral side of sixth abdominal segment with 11 or 12 setae in transverse row, ventro-lateral pair but little if any larger than the setae in row, discal setae, about 24 in number, are almost as large as those in the row. Pleural plates (fig. 1, A) usually well pigmented; plate I irregularly squarish; plate II slightly larger than I and more distinctly squarish; plate III larger than II, IV larger than III, V larger than IV, and all of these more or less squarish; plate VI broader than long, rounded and with spiracle in the middle; plate VII very small, as broad as long. Legs rather short; femur I, one and a half times as long as broad; tibia I about twice as long as broad. Tubercle on femur III rather conspicuous and well chitinized.

Length of an average-sized, unengorged female, 2.75 mm.; width, 0.90 mm.

Male.—Leg I enlarged as usual; first tarsal segment about as broad as long, second tarsal segment about one and a half times as long as broad. Chaetotaxy of thumb of tibia I (fig. 7) as follows: Chief, or terminal, spine extending beyond margin of thumb by less than half its length; anterior accessory spine situated almost on the inside of thumb, spinelike and somewhat longer than terminal

thumb; (in this variety of *P. humanus* one of the setae on the anterior side of the thumb is situated nearer the tip of the thumb than the usual accessory spine, and this seta is in this instance decidedly spinelike, hence apparently there are two anterior accessory spines); outer posterior accessory spine very long, situated nearer the outer margin of the thumb than the chief spine and extending beyond the margin of thumb by over one-half its length; inner posterior accessory spine the stoutest of all the accessory spines and about as long as the chief spine. Femur III without indication of posterior tubercle. Pleural plates similar to those of female except for plate I which is smaller, more irregular in shape and less squarish.

Length of medium-sized individual, 2.30 mm.; width, 0.70 mm.

Type host and type locality.—By process of elimination the Caucasian race of mankind has become type host. No type locality.

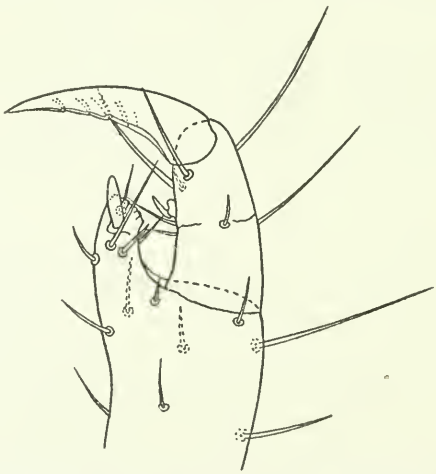

Fig. 7.—Ventral, or posterior, view of end of left anterior leg of male of pediculus (pediculus) humanus Linnaeus, taken in Germany

This description is based upon a lot of 3 females and 3 males collected at Eberswalde, Germany, by Doctor Krausse. By comparing these specimens with the descriptions of the early entomologists of Europe for the type of head louse found on white man the writer is convinced that they really represent the *P. humanus humanus* of Linnaeus. The variety stands out conspicuously among the pure varieties of the head lice of mankind studied by the writer in several respects. First, it is more slender, with somewhat shorter antennae, the thoracic spiracles are decidedly larger in proportion to the size of the body, the body setae are more numerous and nearly all of them are peglike or spinelike and less than half of them are in transverse rows, the chaetotaxy of the thorax is distinctive, and a few other characters of minor importance are noted.

Although the writer has examined many lots of *Pediculus* from man he has seen no other lot that he would refer unqualifiedly to this variety, although some taken from an Eskimo in Greenland are near it and not at all of the type of *P. humanus americanus* or *P. humanus angustus.*

Head lice commonly found in America are of various types. Most of them appear to be either hybrids between the American Indian head louse, and the Caucasian head louse; or between the Caucasian head louse, and the Caucasian body louse, or the louse of the American negro; our American negro apparently has no distinctive head or body louse.

GEOGRAPHICAL AND HOST DISTRIBUTION OF THE GENUS PEDICULUS IN THE NEW WORLD

The problem of the host distribution of *Pediculus* in America is the most interesting, in the writer's opinion, of that of any genus of any group of ectoparasites. In this genus are found species so closely allied in their structural characters that more than one authority has claimed that they belong to a single species, yet the hosts of these closely related species are so far separated that not only are they regarded as belonging to different families but to families that are held by mammalogists to have no immediate phylogenetic relationships.

As has been shown in previous pages of this paper, the *Ateles*-infesting species and those infesting man are in reality not so nearly related structurally as has been supposed, and in fact are amply distinct in regard to the shape of the typical pleural plates. Yet, granting these essential differences, the conviction still remains that by comparison with other Anoplura of primates all species of *Pediculus* are remarkably alike.

As previously stated, different theories may be advanced to explain this unusual diversity of the two kinds of hosts. Kellogg (1913) believed that the close relationship shown by the Pediculi themselves indicated some sort of phylogenetic relationship of the hosts.

The writer's suggestions (Ewing, 1924) in regard to the significance of the host distribution of *Pediculus* in America, are two: First, it may be that here we have a case of a crossing over of the parasites from their original and favored hosts to another distantly related host group. In other words, it would appear that the spider monkeys obtained their pediculids from man, when the latter reached tropical America in his dispersion from the Old World. That such a crossing over from one host group to another with no near phylogenetic relationhip has taken place appears very probable in the case of the biting lice of the family Gyropidae (Ewing, 1924).

That these Gyropid lice have as their favored hosts certain groups of rodents appears almost certain, since it is on rodents that nearly all the species are found, and it is on certain rodents that those members of the family with the most generalized structures occur. Yet several species of Gyropidae occur in nature on American ungulates and upon these ungulates are unusually prolific.

In regard to the theory that *Ateles* species have acquired their Pediculids from man, it is important to note that the pelage of the monkey-hosts is very similar to that of the head of man in coarseness and abundance, also that the blood of *Ateles* is physiologically more nearly like that of man than the blood of most monkeys.

On the skins of their hosts lice find themselves in a portable habitat, and, in the case of mammal-infesting lice, one that differs from that of free-living species in that its temperature is uniform or nearly so. Except for these two elements, portability and uniformity of temperature, the pelage environment of a louse is to be compared exactly to the grass environment of a grasshopper or the forest environment of a sloth. Having two similar environments in nature for a certain free-living species, we observe that the breaking down of a natural barrier between them causes the inhabitants of the one to spread and occupy the other. Having similar environments for *Pediculus* in the head of man and in the fur coat of *Ateles* it is conceivable that the breaking down of the natural barriers by the invasion by man of the territory of the monkeys and by his intimate association with them, might cause some of his lice to spread to a simian environment.

The second explanation advanced by the writer (Ewing, 1924) is that in *Pediculus* we have one of those generalized types which is to an unusual degree free from the influences of its environment. If this is true we would expect it to be a very old type and one which is now found on widely diversified host groups. Some of the Mallophagan genera, *Philopterus* for example, are found on a great many bird groups, both land and acquatic. If this be the true explanation we must expect *Pediculus* to be eventually recorded from several diverse groups of primates. In this connection it should be noted that Fahrenholz (1913 and 1917) reports *Pediculus* from various species of gibbons *(Hylobates)* of the Old World.

If the phylogeny of the *Ateles*-infesting Pediculids has followed that of their hosts it is observed from our knowledge of them that the lice have been in America for a long geological period. According to Elliot (1913), the genus *Ateles* has a very great area of distribution (fig. 8) extending from south central Brazil to as far north as the state of Vera Cruz, Mexico, and on the continent of South America from the Pacific slope of Ecuador to the Atlantic coast of

Brazil. In this vast area, in which the monkeys are found only in the forests, the genus is broken up into geographical species, as for example; *Ateles pan* is found from the state of Vera Cruz, Mexico, south into Guatemala; *Ateles fusciceps* is found in Trans-Andean Ecuador, and *Ateles hybridus* is limited to the valley of the Magdalena, Colombia. Species differentiation in this group appears to have followed dispersion, and this dispersion shows a spread over an immense area several thousands of miles in extent.

If the first suggestion, the "cross-over theory," is rejected, we then find that the solution of the distribution problem of *Pediculus* and the problem of the origin of the genus in the Americas become de-

FIG. 8.—MAP SHOWING THE DISTRIBUTION OF SPIDER MONKEYS (ATELES), BASED CHIEFLY ON RECORDS GIVEN BY ELLIOTT

pendent upon that of the distribution and origin in this continent of the hosts. The problem then hinges upon the work of the mammalogist more than on that of the entomologist.

SUMMARY

1. In America two distinct groups of *Pediculus* exist, one of them confined to man and one to monkeys.

2. The forms infesting man are apparently largely hybrid races of head lice, the pure strains of which were originally found on the white, black, red, and yellow races of man living in their original geographic range.

3. The pure races of these head lice should be regarded as distinct varieties, for they differ in definite morphological characters.

4. Most of the characters used by the earlier entomologists for separating these varieties of man-infesting pediculi are not reliable since they are based either upon characters of hybrids, or characters that come under the category of individual variation, or those due to faulty technique.

5. No evidence was procured during this investigation indicating that the different primary races of mankind each harbored a different variety of clothes louse, as well as a different variety of head louse. The opinion still prevails that in certain races of man a distinct variety of clothes louse developed from the head-louse type for that race; while in other races no clothes-louse type distinctive from the head louse developed.

6. The monkey-infecting pediculids of America, so far as known, fall into distinct species according to the hosts they infest, thus indicating, to a certain degree at least, a parallel host and parasite phylogeny.

7. If these monkey hosts (*Ateles*, species) procured their lice from man it was not from recent man but from human hosts that lived tens of thousands of years ago—long enough to allow a species differentiation to develop among the monkey hosts.

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EXPLANATION OF PLATES.

All photographs were made by J. G. Pratt, and all are of the same magnification, X 20.

PLATE 1.

FIG. 1. *Pediculus* (*Parapediculus*) *consobrinus* Piaget; male, from above.
2. *Pediculus* (*Parapediculus*) *consobrinus* Piaget; female, from above.
3. *Pediculus* (*Parapediculus*) *chapini*, new species; male, from below.
4. *Pediculus* (*Parapediculus*) *chapini*, new species; female, from above.

PLATE 2.

FIG. 5. *Pediculus* (*Parapediculus*) *lobatus* Fahrenholz; incompletely formed female inside of last nymphal skin; from above.
6. *Pediculus* (*Pediculus*) *humanus nigritarum* Fabricius; male, taken from negro boy in Africa; ventral view.
7. *Pediculus* (*Pediculus*) *humanus nigritarum* Fabricius; female, taken from negro boy in Africa; ventral view.

PLATE 3.

FIG. 8. *Pediculus* (*Pediculus*) *humanus humanus* Linnaeus; female, taken in Germany; dorsal view.
9. *Pediculus* (*Pediculus*) *humanus americanus*, new variety; female, taken from the scalp of a prehistoric American Indian mummy collected at Canyon del Muerto, New Mexico; ventral view.

FIG. 10. *Pediculus* (*Pediculus*) *humanus americanus*, new variety; female, taken from the scalp of a prehistoric American Indian mummy, collected at Surco, Peru; ventral view.

11. *Pediculus* (*Pediculus*) *humanus americanus*, new variety; male, taken from the scalp of a prehistoric American Indian mummy, collected at Canyon del Muerto, New Mexico; ventral view.

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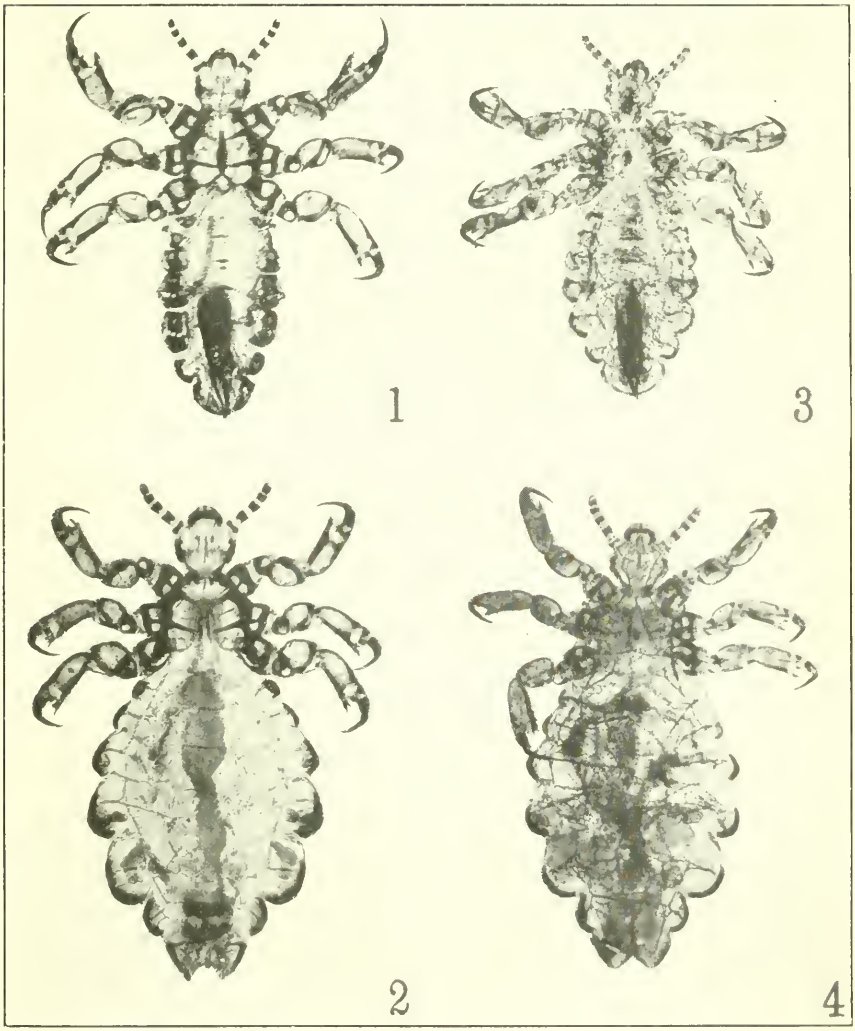
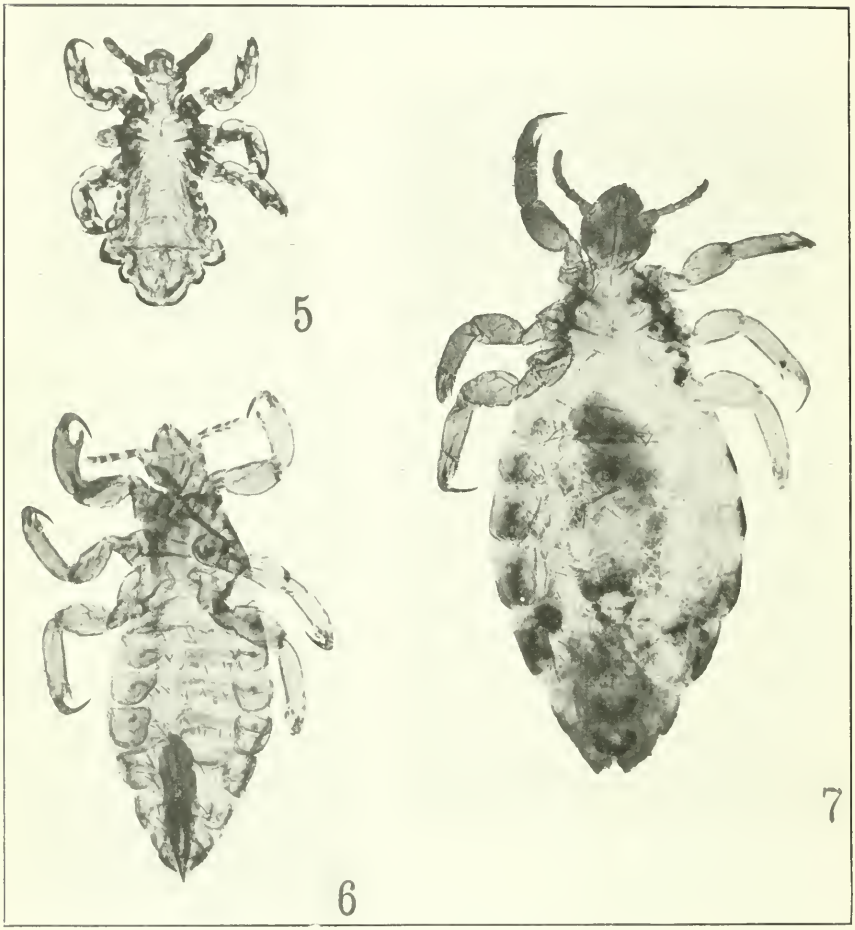


PEDICULI FROM MONKEYS

FOR EXPLANATION OF PLATE SEE PAGE 29



PEDICULI FROM A MONKEY AND FROM NEGROES

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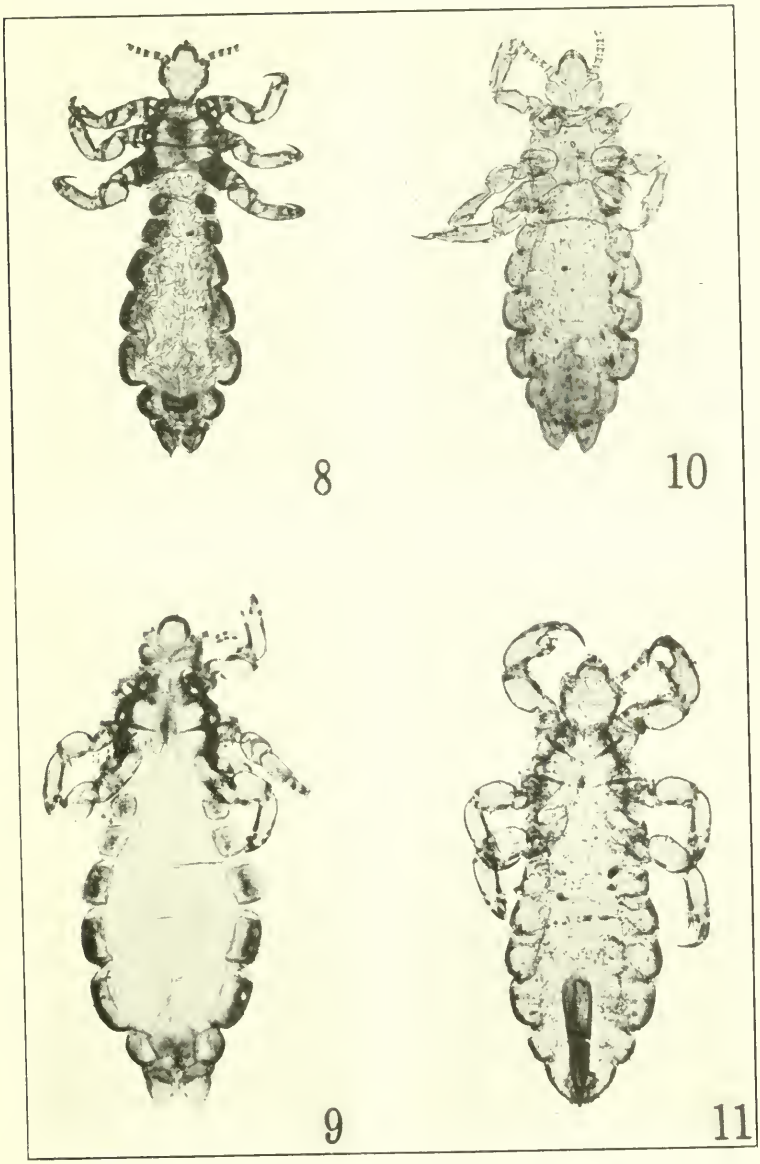

PEDICULI FROM MAN

FOR EXPLANATION OF PLATE SEE PAGES 29 AND 30

A NEW GENUS AND SPECIES OF BORBORID FLIES FROM SOUTH AMERICA

By Mario Bezzi
Of Turin, Italy

Through the courtesy of Dr. J. M. Aldrich, of the United States National Museum, I have received for study a most extraordinary acalyptrate fly, collected in Bolivia by Dr. William M. Mann, when he was a member of the Mulford Biological Exploration in 1921–22.

The fly belongs to the Borboridae. Owing to the conformation of the hind tarsi it is a member of the *Borboridae verae*,[1] and on account of the presence of a pair of strong ocellar bristles, it is more nearly allied with the genus *Borborus*, in the broad sense, than with the South American genus *Archiborborus* Duda, 1921. But it is abundantly differentiated from all the known genera by the following peculiarities: Form of face, presence of a pair of decussate bristles on anterior part of frons, great development of the prelabrum and of the proboscis, presence of three sternopleural bristles, great development of the postscutellum and of the mesophragma, form and structure of the abdomen, rounded terminal bend of the fifth longitudinal vein, length of the sixth longitudinal vein, etc.

Especially the form and structure of the proboscis are very strange and different from what is observed in the acalyptrate flies, recalling the condition present in some Empididae, or in the Bombyliid genus *Empididelcus* Becker. In the Phoridae and in the Acalyptratae (with the exception of the Conopidae) forms with elongate proboscis are indeed rather scarce and they have as a rule the proboscis thin and geniculate. Thus *Psyllomyia* Loew, 1857, or *Rhynchomicropteron* Annandale, 1912, among the former; and among the latter certain Milichiidae, like *Eusiphona* Coquillett, 1897, *Paramyia* Williston, 1897, *Aldrichiella* Hendel, 1911, and even *Madiza* (*Mallochiella*); a number of Trypaneidae, like *Myiopites*, *Ensina*, etc.; some Chloropidae, like *Siphonella;* or Ephydridae, like *Rhynchopsilopa* Hendel, 1913, etc.

[1] O. Duda, Tijdschr. v. Entom., vol. 64, 1921, p. 124, and Archiv. fur Naturgesch., vol. 89, Abt. A, 1923, pp. 42–52. See also A. Spuler, Proc. Acad. Nat. Sci. Philadelphia, vol. 75, 1923, pp. 369–378.

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Curiously enough the nearest resembling form of proboscis found in the literature is that of a fly likewise from Bolivia, described by Professor Hendel under the name of *Drosophilura caudata;*[2] but this fly was subsequently recognized as the female of *Zygothrica dispar* Wiedemann, 1830,[3] and as I can see in specimens from Brazil in my collection its proboscis is in reality very different from that of the new genus here described, and normally shaped.

Another striking feature is what I assume to be the exceedingly developed prelabrum or anterior swelling of the fulcrum of the proboscis (fig. 2, *prl.*) In other members of the family it is much less developed and of usual form, as figured by Wesche (who calls it labrum) for *Borborus equinus*,[4] or by Peterson (who calls it *tormae*) for the same species,[5] or by Frey for *Sphaerocera subsultans*.[6] In other genera of Acalyptratae the prelabrum is conical and projecting, for example in *Coelopa;* and even in the Calliphorid genus *Bengalia* it is shaped as a prominent lamella; but I know no other fly in which it presents such a development as an entirely exposed organ.

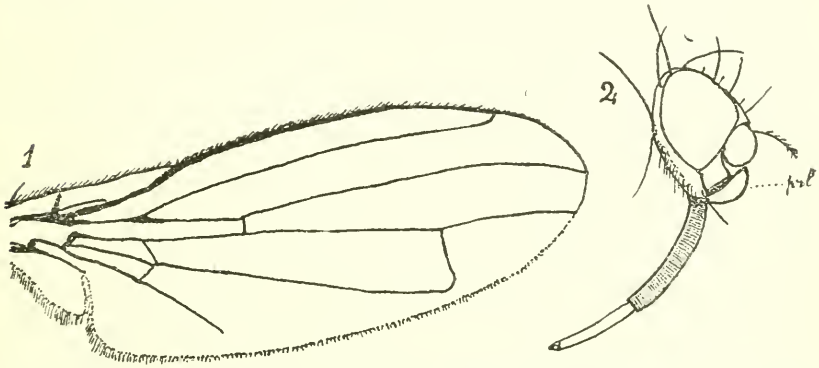
PYCNOPOTA, new genus

Species of elongate body and of rather small size, with cylindro-conical abdomen and with the legs rather slender and simple in both sexes.

Head (fig. 2) not broader than the thorax, in profile a little more high than long, in front view distinctly more broad than high. Occiput convex, but very little prominent, the distance from the neck to the vertex being distinctly shorter than the length of the frons; vertex not carinate, gently rounded. Frons flat, parallel-sided or only a little broadening forward, a little longer than broad; ocellar spot rounded, small, but very little prominent, with 3 well-developed, equidistant ocelli; middle stripe twice as broad as one of the parafrontalia, with parallel sides, quite bare, with less differentiated triangle, with the anterior broader a little concave and produced above the root of the antennae; lunula very small, visible only from in front; parafrontalia curved below anteriorly, with only 3–4 isolated hairs between the frontal bristles. Face short and deeply concave, with distinct middle keel and with broad and prominent mouth border; parafacialia linear, peristomialia short but rather broad in front, only a little more narrow than the third antennal joint. Eyes with rather broad areolets, quite bare; they are regularly rounded on the upper half, but in the lower half they are rather narrowed on account of the deep concavity of the face.

[2] Entom. Mitteil., vol. 2, 1913, p. 387, fig. 2.
[3] A. H. Sturtevant, Proc. U. S. Nat. Mus., vol. 58, 1920, pp. 155–158.
[4] Journ. Royal Micr. Soc., 1904, p. 41, pl. 8, fig. 11.
[5] Illinois Biolog. Mon., vol. 3, 1916, p. 221, pl. 4, fig. 63; pl. 10, fig. 188; pl. 15, fig. 342; pl. 24, fig. 565.
[6] Acta Soc. pro Fauna et Flora Fennica, vol. 48, 1921, pl. 4, fig. 49.

Prelabrum exceedingly developed and prominent, shaped as a conical, erected organ, which is larger than the third antennal joint. Mouth opening small and closed by a membrane around the base of proboscis. Palpi not distinguishable. Proboscis very thick and strong, cylindrical, minutely ribbed, and of about the same breadth throughout its whole length, slightly curved and extending to the middle coxae; more than the basal half is shaped as a sheath, from which is exserted the terminal part, which is a little swollen and provided with a middle longitudinal furrow; the terminal flaps seem to be very minute. Antennae with the basal joints hidden below the anterior border of frons; third joint rounded; arista thin and short, inserted near the base of upper border, not longer than the breadth of frons, with short plumosity on the upper side, with only 2–3 hairs below.



FIGS. 1–2.—PYCNOPOTA MANNI, 1 WING; 2, HEAD; PRL=PRELABRUM. ALL FIGURES SCHEMATICAL AND GREATLY ENLARGED

Cephalic chaetotaxy: 1 postocular, 1 vertical, 1 ocellar, 2 orbitals directed inwardly, 1 decussate in front of the frontal stripe; vibrissae rather weak; no genal bristle; peristomial border with a simple row.

Mesonotum convex on the back, a little more long than broad, with rather prominent shoulders; transverse suture broadly interrupted in the middle; pleural sutures distinct; scutellum small and rounded; postscutellum greatly developed, of about the same size as the scutellum itself; mesophragma convex and likewise greatly developed, with a prominent rounded tubercle on each side. Halteres normal; calypters rudimentary, with long soft cilia at border.

Back of mesonotum bare and rather shining, destitute of longitudinal rows of setulae, with only one row of acrostichal on each side, extended from the fore border to the scutellum; 3 rather strong dorsocentral, one of which is before the suture; 1 humeral, 1 praesutural, 2 notopleural, 1 anterior supraalar, 1 posterior supraalar; just above the shoulder several bristly hairs, one longer and

erect on the shoulder itself; sternopleura with three bristles placed in a triangle, but no other pleural bristles. Scutellum with 4 marginal bristles, bare on the disk and at border.

Abdomen cylindroconical, in both sexes with 5 visible segments, the genital ones not counted. Tergites and sternites not always differentiated, the membrane sometimes running uninterrupted around the abdomen; there are no true bristles, but the tergites have long bristly hairs at hind border and sides; even the lateral membrane of the middle segments is clothed with short, thick setulae. Male hypopygium open, but of rather small size and narrow, not broader than the last abdominal segment. Female ovipositor thick; the basal segment (the only one visible) as long as the two last abdominal segments together, but more narrow; terminal lamellae small and pubescent; a strong projecting spine below.

Legs rather slender, femora not thickened, quite simple in both the sexes; femora and tibiae with short bristly hairs, the latter with only one preapical hair, tarsi of the hind pair with the basal joint considerably thickened but not much shorter than the following joint; claws short, curved, simple; pulvilli short.

Wings (fig. 1) rather long and narrow, parallel-sided, with smooth, unspotted membrane. Costa extending to the end of fourth vein, with short ciliation and with minute setulae on the 2 basal segments; an isolated rather long bristle near the extreme base. Auxiliary vein free, extended to a little beyond middle of first vein and ending very close to it; humeral crossvein rather thick. First vein short, meeting the costa before the first third of anterior wing border, and considerably before the small crossvein. Second vein long and rather straight, upcurved at end, the third segment of costa being less than one-third of the length of the second. Third vein rather straight but distinctly curved down at end, ending precisely at wing tip. Small crossvein short and perpendicular, placed a little before the first third of the discoidal cell. Fourth vein straight, its last section being not much longer than the half of the preceding section. Fifth vein toward the end curved up in a rounded bend very near hind border of wing, and thus forming the hind crossvein, which is placed perpendicularly and parallel with the small one. Sixth vein straight, much longer than in allied forms, completely chitinized throughout its whole length, but ending considerably before hind border of wing. Anal crossvein inwardly oblique, meeting at fifth vein in one point or nearly so with the middle basal crossvein, the anal and second basal cells being thus of about the same length. Auxiliary lobe broad, alula rather rectangular, both with long, soft ciliation at border.

Genotype.—*Pycnopota manni*, new species.

PYCNOPOTA MANNI, new species

A small, reddish-brown fly with yellowish legs and whitish abdomen, of which the sclerites are sometimes blackish.

Length of body: (male) 2.5 mm., (female) 4 mm.; of wing 2.8–3 mm.

Head blackish, opaque, with reddish frontal stripe and reddish or yellowish peristomalia. Antennae pale yellowish. Prelabrum shining reddish; sheath of proboscis shining black, finely wrinkled; terminal portion of proboscis shining reddish; buccal membrane white. All the cephalic bristles and hairs black.

Mesonotum shining reddish-brown or black, blackish along the middle stripe and on a rounded spot on each side of the transverse suture; pleurae more pale and less shining, but the mesopleura more or less darkened. Scutellum shining reddish, more or less darkened red; postscutellum and mesophragma opaque, reddish. All the bristles and hairs black. Halteres dirty whitish, their rounded knob snow-white.

Abdomen dirty whitish; but the sclerites, when developed, are opaque blackish or even black; in the male type only the tergites of the first two segments are well chitinized; in the female type all the tergites and the much smaller sternites of all the five segments are well developed; one additional female specimen has the tergites on first, second, and fifth segments chitinized and the sternites only on fifth segment; in another female there is distinct only the tergite of the first segment. The bristly hairs are black, the smaller hairs are dark reddish; the setulae on sides of middle segments (type female) are placed on small blackish dots, very distinct on the whitish membrane when the abdomen is distended. Hypopygium dirty whitish, blackened below. Basal segment of the ovipositor (sixth abdominal segment) dirty whitish, but always with well developed, black tergites and sternites, in one case only the tergites being not distinct. Terminal lamellae dirty brownish; terminal spine quite black.

Coxae and legs entirely reddish-yellow to the end of tarsi; hairs dark reddish, front femora with a complete row on outer side, the posterior ones with only 2–3 apically; front tibiae with but one long hair toward the middle; hind tibiae with a row of 5–6 scattered long hairs at hind side. Claws blackish, pulvilli dirty whitish, in the male only a little more developed than in the female.

Wings slightly grayish, iridescent, with dark yellowish veins, the costa being more dark, chiefly along the but little thickened second segment.

Described from one male and three females collected on the Mulford Biological Exploration at Huachi Beni, Bolivia, September,

1921, by Dr. W. M. Mann, in whose honor this strange insect is named.

Type.—Male, Cat. No. 28291, U.S.N.M., allotype female, and one female paratype; another female paratype in the writer's collection.

One of the female paratypes shows a cluster of six gamasid nymphs attached on back of abdomen, between the second and third segments; there is moreover one isolated nymph on venter, between the first and second sternites. This fact may perhaps be considered as an indication of fimicolous habits of the fly; while on the other hand the physogastric condition of the female is suggestive of some myrmecophilous forms. And the unchitinized abdominal sclerites are very like those observed in *Termitoxenia* and allied forms.[7]

[7] E. Wasmann, Verhandl. des V. Internat. Zool.-Congress. zu Berlin, 1901 (1902), p. 854, No. 2.

NEW GENERA AND SPECIES OF ACALYPTRATE FLIES IN THE UNITED STATES NATIONAL MUSEUM

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In this paper I present descriptions of new genera and species, with some notes on genera and species already described, the relations and distribution of which are imperfectly known, in the families Sapromyzidae, Drosophilidae, and Agromyzidae.

All the type specimens are deposited in the United States National Museum, and all species dealt with are from the New World.

Family SAPROMYZIDAE

The species of this family occurring in Central and South America have not been critically studied in the light of recent generic subdivisions of the family until now, and in the following pages I attempt to place those species available to me in the groups which I assigned the North American forms to in the recent paper by W. L. McAtee and the writer. As recently as 1908 the family was listed as containing 11 monobasic genera, 11 genera containing from 2 to 8 species each, and one large genus with 413 species. This last genus, *Lauxania*, was divided into 6 subgenera, 3 of which were monobasic, one contained 2 species, the remaining species being arbitrarily placed in the other two (67:341). Subsequently Kertesz erected about half a dozen other monobasic genera for the reception of Oriental species, Frey erected two for American species, and the present writer has recently made a realignment of the genera occurring in North America. In this last work one new monobasic genus was erected and characters cited for the subdivision of the heterogeneous group *Lauxania* of authors by means of which several genera previously considered as synonyms were given generic rank. Up to the present I have found no evidence in the examination of much exotic material that the segregations proposed on the basis of the American forms are invalid. In fact, by the use of these

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distinguishing characters, one is led to a better appreciation of the relationships of the forms found in the different faunal regions, which is an impossibility under the old system. A complete elucidation of the generic groups is not possible at this time owing to lack of material, but it is hoped that the data in this paper may throw some added light on the problem.

The family Sapromyzidae is very similar to Sciomyzidae, differing from it essentially only in having the postvertical bristles invariably more or less convergent, sometimes cruciate, and the sixth vein of the wing always falling short of attaining margin of wing, the more typical forms having the vein very short and quite abruptly discontinued.

It appears to me that these characters are rather unimportant for separating families upon, especially as some Sciomyzidae have the sixth vein evanescent at tip and I am more inclined to consider the groups as subfamilies than separate families. This is the more impressed upon me when I come to consider the status of the group for which Dr. F. Hendel has recently erected the family Periscelidae. In his family he, I infer, has included but one genus, *Periscelis* Loew, which genus I included in Sapromyzidae in the paper already referred to above, but the inclusion of three other genera in the group in the present paper does not convince me that they are entitled to family rank. All have the postvertical bristles divergent and the sixth-wing vein incomplete, being in these respects intermediate between the normal forms of Sapromyzidae and Sciomyzidae. All the four genera also have the auxiliary vein of wing incomplete, which character is not in keeping with the definition of the larger group in which they have been placed by Hendel, but they are in habitus very similar to many Sapromyzidae and the general wing characters are otherwise as in *Steganopsis* to a very marked extent in one or two of the genera.

I incline to the opinion that these groups should form subfamilies of Sapromyzidae, but beyond expressing this opinion do not intend to discuss the matter at this time.

I present in this paper a synopsis of the four genera of Periscelinae as no such synopsis is in existence up till this time.

Subfamily Sapromyzinae

A partial synopsis of genera of this subfamily is presented on a subsequent page in this paper, and indications of relationships of new genera are invariably given where such genera are erected.

XENOPTERELLA, new genus

Generic characters.—Differs from all other genera in this family in possessing two transverse veins between the third and fourth longi-

tudinal veins, one before and the other beyond the outer cross vein. The head is similar to that of *Sapromyza* and *Minettia*, the intra-alar bristle is present as in the latter genus, and there is but one sternopleural bristle present. The black costal setulae do not extend to apex of third vein, and the preapical tibial bristle is present.

Genotype.—*Xenopterella obliqua*, new species.

XENOPTERELLA OBLIQUA, new species

Male and female.—Shining fulvous yellow. Ocellar spot and a mark on middle of occiput fuscous; a mark between each antenna and eye, and the palpi, black. A large mark across upper part of sternopleura, and most of scutellum, fuscous. Abdomen more or less infuscated. Legs yellow. Wings yellowish hyaline, with dark brown and yellowish markings as in figure 1.

Frons distinctly less than half of the head width, orbits hardly differentiated, ocellar bristles longer than the postverticals and orbitals; arista distinctly pubescent; eye about as high as long; face not convex. Thorax with three pairs of postsutural dorsocentrals and one pair of distinct prescutellar acrostichals; intradorsocentral setulae in about six series; intra-alar rather weak; scutellum convex, bristles subequal; propleural bristle not distinguishable in any specimens before me. Fore femur without anteroventral comb; hind femur without distinct preapical anteroventral bristles. Venation as in figure 1; veins not setulose.

Length, 4 mm.

Type.—Male allotype, and one paratype in poor condition, Mexico City, Mexico, May 22, 1922 (E. G. Smyth). Cat. No. 28437, U.S.N.M.

This species has much the appearance of a Trypetid, but is a true Sapromyzid.

STENOLAUXANIA, new genus

Generic characters.—Similar to *Lauxaniella* Malloch, differing from it in having the face transversely striate, the frons with fainter striae, and the anterior orbital bristle curved mesad.

Genotype.—*Stenolauxania striata*, new species.

STENOLAUXANIA STRIATA, new species

Male and female.—Black, subopaque, abdomen shining. Head black, interfrontalia shining, with a slight violet or purple tinge, orbits opaque black; face shining; first and second antennal segments and extreme base of third yellow, remainder of third black; arista black; palpi fuscous. Thorax with a slightly shagreened appearance on dorsum. Abdomen black. Legs tawny yellow, apices of fore

tibiae and basal two segments of fore tarsi black. Wings fuscous, with a broad costal streak on basal two thirds, and a spot in first and second posterior cells, hyaline.

A slender species. Ocellar bristles microscopic; postverticals minute; anterior incurved orbital bristles small; interfrontalia shagreened and more of less transversely striate; face rounded out in centre and with numerous quite prominent transverse striae; basal segment of antennae as long as second; haired below, third segment about seven times as long as wide, entire antennae distinctly longer than height of head; arista plumose. Prescutellar acrostichal bristles absent. Fore tarsi elongate and thickened. Inner cross vein distinctly beyond middle of discal cell; extreme apex of fourth vein bent down slightly.

Length, 4-5 mm.

Type.—Male, allotype, and five paratypes, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28438, U.S.N.M.

This species is readily distinguished by its striate face and marked wings, though one species of *Lauxaniella*, *nubecula*, described in this paper has the wings marked in similar manner.

LAUXANIELLA NUBECULA, new species

Male.—Black, shining. Head black, frontal orbits, face, and cheeks, glossy, parafacials and sides of occiput silvery pruinescent; arista and basal two segments of antennae yellow, third segment black. Thorax black, slightly shining, greasy in type, but apparently with whitish pruinescence, a dark central, and interrupted lateral, dorsal vittae; apex of scutellum velvety black; pleura whitish pruinescent. Legs pale yellow, with white dusting on tibiae and tarsi, coxae and femora blackish, apices of latter yellow. Wings dark brown, hyaline at base, rather broadly along costa to beyond middle, and in outer part of second posterior cell. Halteres yellow.

Frons a little over one-third of the head width at vertex, wider anteriorly, each orbit wider than interfrontalia above, equal to it below; ocellars weak; orbitals strong; total length of antenna greater than height of head, basal two segments subequal in length, third about ten times as long as wide, and longer than arista, the latter plumose; face smooth, prominently and evenly convex, with a linear diagonal depression on each side below eye level. Thorax and abdomen slender. Preapical tibial bristle distinct. Inner cross vein beyond middle of discal cell.

Length, 6 mm.

Type.—Cano Saddle, Gatun Lake, Panama Canal Zone, August 6, 1923 (R. C. Shannon). Cat. No. 28474, U.S.N.M.

This is the largest species of the genus known to me and the only one so far described in which the wings are distinctly pictured. The wing markings resemble those of *Stenolauxania striata* described in this paper.

CEPHALELLA, new genus

Generic characters.—Resembles *Lauxaniella* Malloch, having the antennae similar and the anterior orbital bristle sloping backwards. The face is prominently convex, with a large rounded convexity outstanding on each side; the labrum is exposed and over half as high as face below antennae; the postverticals are of moderate size, situated just below the sharp vertex; ocelli small and quite close, no ocellars present; eye higher than long. Propleural bristles indistinguishable; sternopleural 1.

Genotype.—*Cephalella fumipennis*, new species.

CEPHALELLA FUMIPENNIS, new species

Female.—Head shining testaceous yellow, a small blackish mark on ocellar region and another at base of each anterior orbital bristle, the large lateral facial convexities and labrum deep black, with a violet tinge, centre of latter yellow; third antennal segment and palpi fuscous. Thorax testaceous yellow, dorsum anteriorly with lateral margins and three discal vittae fuscous, these posteriorly entirely fused; pleura yellowish only anteriorly and on lower posterior portion. Abdomen shining black. Legs testaceous yellow, fore tarsi black, apices of fore femora, of hind tibiae, and of mid and hind tarsi, darkened. Wings brown, paler posteriorly and in centre of cells. Halteres brown.

Head higher than long; frons about 1.5 as long as wide and fully one-third of the head width, surface glossy, orbits not differentiated, bristles of moderate length, hairs absent; antennae elongate, basal segment as long as second, haired at apex below, the two combined about one-fourth as long as third, the latter slender, about ten times as long as wide; arista shorter than third antennal segment, plumose. Thorax elongate, with two or three pairs of dorsocentrals in front of scutellum and a series of hairs in line with them anteriorly. Fore femur without anteroventral comb; fore tibia and tarsi thickened. Inner cross vein at about two-fifths from apex of discal cell; outer at fully its own length from apex of fifth; last section of fourth about 2.25 as long as preceding section.

Length, 5 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28439, U.S.N.M.

Genus CAMPTOPROSOPELLA Hendel

As there are several new species of this genus amongst the material before me, I present a complete key to the species of the genus known from the New World.

KEY TO SPECIES

1. Wings largely or entirely fuscous brown, or with clear-cut dark markings 2
   Wings hyaline or slightly yellowish 3
2. Wings almost entirely fuscous brown; dark brownish species. ..... dolorosa Williston.
   Wings with clear-cut dark markings; testaceous yellow species. ..... maculipennis Malloch.
3. Thorax and abdomen black; third antennal segment black ..... atra, new species.
   Thorax and abdomen entirely or almost entirely yellow; third antennal segment black at apex only 4
4. Palpi entirely yellow ..... flavipalpis, new species.
   Palpi black at apices 5
5. Abdomen with a large black spot on each side of third and another on fourth tergite; prescutellar acrostichals absent ..... latipunctata, new species.
   Abdomen without black spots 6
6. Arista more sparsely plumose above ..... vulgaris Fitch.
   Arista densely plumose above ..... verticalis Loew.

CAMPTOPROSOPELLA ATRA, new species

Male and female.—Head yellow, ocellar spot and third antennal segment black, palpi fuscous. Thorax and abdomen shining black. Legs tawny yellow, coxae, mid and hind femora almost entirely blackened, fore femora less so. Wings slightly brownish. Halteres fuscous.

Ocellar bristles about as large as the postverticals and incurved anterior orbitals; third antennal segment not much tapered apically, fully twice as long as its basal width; arista moderately densely plumose. Prescutellar acrostichals small.

Length, 2.25 mm.

Type and 2 paratypes.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28440, U.S.N.M.

The only known black species of the genus.

CAMPTOPROSOPELLA LATIPUNCTATA, new species

Female.—Shining tawny yellow. An oval spot over ocelli, apices of third antennal segment and palpi, and a large spot on each side of third and another on fourth visible tergite, black. Fore tarsi brownish. Wings yellowish.

Frons half of the head width; ocellar and postvertical bristles fine and not very long; third antennal segment fully 2.5 as long as wide; arista as in *vulgaris* Fitch. Thorax without prescutellar

acrostichal bristles. Inner cross vein about three-sevenths from base of discal cell; penultimate section of fourth vein half as long as ultimate.

Length, 3 mm.

Type and 5 paratypes.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28442, U.S.N.M.

CAMPTOPROSOPELLA FLAVIPALPIS, new species

Female.—Similar to the preceding species in color, but the ocellar spot is very small and much paler, the palpi are entirely yellow, and the abdomen lacks the large black lateral dorsal spots.

Frons not half of the head width; ocellar bristles very fine and close together at bases. Prescutellar pair of acrostichals present. Inner cross vein at two-fifths from base of discal cell; penultimate section of fourth vein fully four-fifths as long as ultimate section.

Length, 3 mm.

Type and 5 paratypes.—San Mateo, Costa Rica (P. Schild). Cat. No. 28441, U.S.N.M.

The only species with unmarked wings and yellow palpi so far recorded.

SETULINA, new genus

Generic characters.—Similar to *Minettia*, but the base of stem vein (radius) is furnished with a series of setulae on its hind side above proximad of humeral vein.

Genotype.—*Setulina prima*, new species.

SETULINA PRIMA, new species

Female.—Tawny yellow, thorax and abdomen shining. Frons opaque, shining only on orbits and triangle; ocellar spot black; sides of face white dusted. Abdomen with black apices to tergites, the dark color carried angularly forward on median line, especially on tergites 3 and 4. Legs yellow. Wings yellowish hyaline, a deep brown mark along costa from apex of auxiliary vein which extends over second vein to beyond outer cross vein at which point it expands, covering tip of wing from costa to a little over fourth vein, a quite conspicuous dark brown cloud over each cross vein, the one on inner connecting with the costal streak. Halteres dusky yellow.

Frons less than one third of the head width, surface hairs weak, orbital bristles strong, recurved; ocellar bristles of moderate length, shorter than the cruciate postverticals, the latter far removed from posterior ocelli; arista rather long haired; cheek very narrow; upper postocular setulae very strong. Thorax with two pairs of strong, and one pair of weak, anterior, dorsocentral bristles, a pair of long prescutellar acrostichals, intra-alar strong, one bristle behind

and two in front of supra-alar; intradorsocentral setulae in about 12 series; both sternopleurals strong; mesopleura with a few short bristles besides the usual long one; scutellum flat above, bristles equal; prosternum haired. Abdomen stout. Fore femur without anteroventral comb; mid femur with a series of short stout bristles on apical half of anterior surface, and one at apex on posterior surface; mid tibiae unarmed posteriorly. Inner cross vein at about one third from base of discal cell; last section of vein 4 about twice as long as preceding section.

Length, 6 mm.

Type.—Cacao Trece Aguas, Alta Vera Paz, Guatemala (Barber and Schwartz). Cat. No. 28443, U.S.N.M.

DRYOMYZOIDES, new genus

Generic characters.—Ocellar bristles minute, postverticals and orbitals long, anterior orbitals farther from eye than posterior pair. Intra-alar present; anterior sternopleural minute. First and third wing veins setulose above, the former apically, the latter basally to beyond inner cross vein.

Genotype.—*Dryomyzoides advena*, new species.

DRYOMYZOIDES ADVENA, new species

Male and female.—Tawny yellow, shining. Face white dusted on sides; ocellar spot dark. Fore tarsi from before apex of basal segment, mid and hind pairs with apical two segments, blackish. Wings clear, both cross veins, and to a lesser extent the apices of third and fourth veins, slightly clouded.

Orbits not differentiated; surface of frons with some minute hairs; arista pubescent; lower margin of back of head with two long downwardly directed bristles on each side; eye higher than long. Thorax with three pairs of strong dorsocentrals, a strong pair of prescutellar acrostichals, and about 10 series of intradorsocentral setulae; scutellum flat above, transverse between the apical bristles; prosternum bare; propleural bristle minute. Bristles on apices of abdominal tergites strong; hypopygium of male small; genitalia of female without thorns. Fore femur without the anteroventral comb; mid tibia without distinct posterior median bristles. First posterior cell of wing slightly narrowed apically; the three sections of fourth vein subequal in length; sixth vein rather long and distinct, extending almost to margin of wing; outer cross vein at not more than half its own length from apex of fifth vein.

Length, 8–9 mm.

Type.—Female, Alta Boa Vista, Rio de Janeiro, Brazil, August 9, 1915 (P. G. Russell). Allotype and one female paratype mounted

on same pin, and one female paratype, Rio de Janeiro, Brazil, December 31, 1918 (R. Fischer, Deutsches Entomol. Institut.). Cat. No. 28444, U.S.N.M.

Agrees well with description of *Dryomyza advena* Wiedemann, but a true Sapromyzid.

NEOMINETTIA, new genus

Generic characters.—Third wing vein with fine widely separated setulae on its underside basally; scutellum with numerous black setulae on sides of disk; posterior inter-alar bristle present; costal setulae not extending to apex of third vein; mid tibia without pronounced bristles on posterior side.

Genotype.—Musca contigua Fabricius.

NEOMINETTIA CONTIGUA (Fabricius)

A shining tawny yellow species with conspicuously marked wings, the markings brown, consisting of a costal streak which extends round apex of wing to fourth vein and fills the marginal cell, a cloud over each cross vein, the one on inner connected with the costal streak, and between it and apex two similar spots projecting from the costal streak on to disk as far as third vein (fig. 20).

Both pairs of orbital bristles strong and sloped backward; ocellars fine, shorter than postvertical pair; arista short plumose. Thorax with three pairs of strong dorsocentrals and one pair of prescutellar acrostichals; a rather pronounced bristle in front of and another behind the supra-alar.

Length, 5.5-6.5 mm.

Described from Brazil and subsequently recorded from Mexico. I have seen it from Colima Vulcano, Mexico (L. Conrad), and Higuito, San Mateo, Costa Rica (P. Schild).

The setulose third vein and scutellum are sufficient to distinguish this genus from its allies, the latter character being unique in the family so far as I know at this time. No other species of the genus is known to me.

CHAETOMINETTIA, new genus

Generic characters.—Third wing vein with a few strong setulae at base on upper surface; mid tibia with some short but distinct bristles on posterior side; intra-alar bristle generally present, sometimes weak; costal setulae not extending to apex of third vein; anterior sternopleural bristle weak or absent.

Genotype.—Chaetominettia spinitibia, new species.

CHAETOMINETTIA SPINITIBIA, new species

Female.—Fulvous yellow. Parafacials with white pruinescence; frons entirely shining. Wings yellowish, both cross veins distinctly but not conspicuously clouded.

All frontal bristles except the ocellar pair strong, the latter very small and weak, the postvertical pair as far behind ocelli as distance of latter from eye, a few fine hairs on orbits; arista plumose; face broadly convex; eye narrowed below. Thorax with three pairs of strong dorsocentrals and one pair of presutural acrostichals; intraalar weak; scutellum flat, apex transverse between bristles, the two pairs of bristles equal. Bristles on apices of tergites of abdomen, except on apical one, rather strong. Fore femur without anteroventral comb; mid tibia with three or four posterior bristles. Inner cross vein close to middle of discal cell; last section of fourth vein but little longer than preceding section.

Length, 5.5 mm.

Type and 2 paratypes.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28145, U.S.N.M.

Distinguished from the following species by the absence of conspicuous marks on the wings.

CHAETOMINETTIA LATELIMBATA (Macquart)

Differs from the preceding species in having the cross veins and apices of veins 2, 3, and 4 conspicuously clouded with dark brown, the clouds on apices of the longitudinal veins carried backward along veins, that on fourth vein nearly connecting with the one on outer cross vein, the one on second extending midway to apex of first vein, and usually there is a fainter costal suffusion nearly to base of wing.

Structurally and in chaetotaxy similar to *spinitibia*, but the outer cross vein is noticeably beyond middle of discal cell.

Length, 4–5 mm.

Apparently a widely distributed species, the material before me being from Trinidad, British West Indies; Panama Canal Zone; Bahia, and Rio de Janiero, Brazil; Costa Rica; and Paraguay.

It is probable that this species has been described under other, and possibly earlier, names than the above, but I can not make certain of this.

In connection with this genus it is pertinent to state that there is one species before me from Panama, which has the third vein bare and bristles on the posterior side of mid tibia. In other respects it appears to be a *Minettia* and is very similar to *spinitibia* described above.

The foregoing four genera are distinguished from all but three or the previously described genera of the family in having one or

more of the discal wing veins with setulose hairs on part of their upper or under surfaces. I present a key to these genera as the best method of elucidating their distinctions.

KEY TO GENERA WITH SETULOSE VEINS

1. Third vein bare both above and below 2
   Third vein setulose either above or below basally 3
2. Base of radius setulose on posterior side above basad of humeral cross vein; second vein bare basad of furcation with third .. **Setulina**, new genus.
   Base of radius bare; second vein on its upper surface with two or more setulae basad of its furcation with third ..... **Xenochaetina** Malloch.
3. First and third veins setulose above; posterior intra-alar bristle strong. **Dryomyzoides**, new genus.
   Only the third vein setulose 4
4. Intra-alar bristle present; third vein setulose below on both sides of inner cross vein; scutellum setulose on sides of disk. **Neominettia**, new genus.
   Intra-alar bristle present or absent; third vein setulose at base above, base below; scutellum without discal setulae 5
5. Mid tibia with some very distinct posterior bristles besides those at apex; intra-alar bristle present, sometimes very weak. **Chaetominettia**, new genus.
   Mid tibia without evident median posterior bristles; intra-alar absent ... 6
6. Fore femur without preapical anteroventral comb; pteropleura bare. **Peplomyza** Haliday.
   Fore femur with a distinct preapical anteroventral comb of short black setulae; pteropleura with some fine black hairs in center. **Eusapromyza** Malloch.

Genus CHAETOCOELIA Giglio-Tos

A genus containing species in which the wings are deep fuscous brown on the costal half or more, the hind margin having a large irregular patch in second posterior cell and the border basad of apex of fifth vein irregularly hyaline. Structurally there is little difference between the genus and *Minettia*, which it most nearly resembles, about the only one consisting of small raised bases to the orbital bristles and a small elevation between each antenna and eye.

CHAETOCOELIA TRIPUNCTATA, new species

Female.—Head and thorax fuscous brown, yellowish at bases of frontal bristles; face yellowish, the usual pair of dark spots not very prominent; antennae brownish yellow; palpi yellow. Abdomen and legs clay yellow. Wings fuscous, hind margin narrowly irregularly hyaline basad of apex of fifth vein, the large marginal hyaline mark in first posterior cell with a slender branch extending almost to fourth vein just behind middle of its last section, a small round hyaline spot a little above fourth vein and about one third from apex of its last section, a similar spot below third vein almost in oblique

line with the last spot and apex of second vein, and a third and slightly larger spot almost directly above the first one and in the cell above it, the three forming and almost equilateral triangle; discal cell all dark; inner cross vein and upper extremity of outer one darker than other veins; costal margin in front of apices of auxiliary and first veins pale. Halteres dusky yellow.

Bases of frontal bristles but little elevated; arista very short pubescent. Thorax with three pairs of dorsocentrals, one prescutellar pair of acrostichals, one pair of strong intra-alars, and about six series of intradorsocentral setulae; scutellum short, flat above. Veins 3 and 4 distinctly divergent apically. Fore femur without an anteroventral comb.

Length, 4 mm.

Type and paratype.—Female, Cat. No. 28446, U.S.N.M., Barro Colorada, Panama Canal Zone, July 18 and 9 respectively (R. C. Shannon).

Most closely related to *angustipennis* (Williston), differing in having the abdomen entirely yellow, the wing without discal celluar marks, etc.

Genus MINETTIA Robineau-Desvoidy

The present concept of the genus *Minettia* is a rather broad one and it is very probable that with further intensive study it may be split into several genera or subgenera. The typical forms, basing this concept upon the genotype, are robust black species with the face more or less tumid on each side below and the wings without conspicuous black markings except sometimes at bases. In these the mid tibia has no distinct median bristles on posterior side and there is never a bristle in line between the intra-alar and supra-alar bristles, while all the wing veins are devoid of setulose hairs. In this paper I include some species in the genus which have posterior bristles on the mid tibia, as well as some which have the thorax with a bristle in line between the intra-alar and supra-alar bristles. There are also several species in which the wings are conspicuously marked apically, and which are much less robust than the genotype, without tumid areas on the lower part of face.

I consider it better to leave these aberrant forms in this genus in the meantime as more material obtained from South America is necessary to enable one to arrive at a definite conclusion as to the merits of the characters referred to as generic indices. Any such aberrations as are present in the species dealt with in the paper are indicated in the text.

I have grouped the species dealt with according to what I consider to be their relationships. The first four all have the face and scutel-

lum punctate with black and belong to the same group as *valida* Walker, the fifth has no spot on the face but has the scutellum bipunctate at apex, while the sixth has the scutellum and face impunctate, though closely related to the fifth. The others except *bipunctata*, are quite distinct from this first group, belonging for the most part to one more aberrant, the mid tibia being bristled in some, and other chaetotaxic characters occurring in all which distinguish them from the other segregates of the genus.

MINETTIA TRIPUNCTICEPS, new species

Female.—Clay yellow, slightly shining, with the following parts black: a vitta on frons occupying the median fourth of its entire surface, basal two segments of antennae, arista, two round spots above middle of face and one on its lower margin, a mark below each eye, sides of labrum, palpi except bases, four vittae on dorsum of thorax, the median pair extending over bases of the apical scutellar bristles, a series of large spots on middle of dorsum of abdomen except on first visible tergite, a narrow fascia on each side on hind margin of each tergite which widens out and extends along the extreme lateral margins. A spot on anterior side at apices of fore femora and a band near bases of mid and hind tibiae fuscous. Wings yellowish, dark brown along costa back as far as second vein, the dark color extending obliquely across wing from a little proximad of outer cross vein to middle of second posterior cell and covering entire apex of wing, both cross veins broadly dark brown, the cloud on outer one almost connected with the dark apical mark, and a dark suffusion along entire length of fifth vein. Halteres yellow.

Structurally similar to *valida* Walker. Frontal bristles except the minute ocellars strong and long; arista plumose. Thorax with three pairs of long postsutural dorsocentral and one pair of prescutellar acrostichal bristles; the intradorsocentral setulae in about ten series. Fore femur without anteroventral comb. Outer cross vein a little over one-third from apex of discal cell.

Length, 4 mm.

Type.—Barro Colorado, Panama Canal Zone, July 16, 1923 (R. C. Shannon). Cat. No. 28447, U.S.N.M.

The tripunctate face, fusion of median thoracic vittae with the normal pair of black spots at apex of scutellum, and conspicuously marked wings separate this species from any of its allies.

MINETTIA OCTOVITTATA Williston

This species is the most closely related to the foregoing. The face has but one black spot, on the lower margin, the cheeks are unspotted, the frontal vitta is much paler and more diffused, the second antennal segment is yellow, the thoracic vittae broader and less intense in

color, the abdomen has three series of black dorsal spots, in addition the lateral edges of both the tergites and sternites are black, and the wing markings are not so extensive nor so dark, there being a rather noticeable isolated spot about middle of last section of fourth vein.

Locality.—Base of Corcovado, Rio de Janeiro, Brazil, August 18, 1915 (P. G. Russell). Originally described from the Island of St. Vincent, British West Indies.

MINETTIA PICTICORNIS Coquillett

Differs from the two preceding species in having the wings almost without dark clouds, only a faint suffusion being present on the two cross veins. The basal two antennal segments are black, the face has but one black spot, there is a faint dark mark on lower margin of cheek at middle, and the thoracic dorsal vittae are narrow and brownish, being much paler than the apical pair of scutellar spots.

Specimens are before me from Panama Canal Zone and Guatemala. Originally described from Nicaragua and subsequently recorded from Texas.

MINETTIA EVITTATA, new species

Female.—Tawny yellow, slightly shining. Face with a round velvety black spot in center of its lower margin; ocellar triangle hardly darkened; antennae yellow, third segment missing in type; palpi yellow. Thorax without vittae; two black spots at apex of scutellum. Apices of abdominal tergites faintly and narrowly darkened, the apical three with a faint dark central line. Legs yellow. Wings marked as in figure 2, the markings fuscous.

A robust species. Postvertical and orbital bristles long and strong, ocellar pair fine and short, surface of frons with numerous fine black hairs; face opaque, almost flat; cheek higher than width of palp, the marginal hairs carried upward to about middle of sides of face; occiput strongly haired, especially below. Thorax with three strong pairs of postsutural dorsocentral and one strong pair of prescutellar acrostichal bristles; the posterior intra-alar strong, and one bristle in line between it and the supra-alar; mesopleural hairs strong, setulose below; both sternopleurals strong. Abdominal tergites with strong marginal bristles. Fore femur without an anteroventral comb; mid tibia without posterior median bristles; hind femur with some short preapical anteroventral bristles. Venation as in figure 2.

Length, 7 mm.

Type.—Barro Colorado, Panama Canal Zone, July 17, 1923 (R. C. Shannon). Cat. No. 28448, U.S.N.M.

A rather aberrant species owing to the presence of a distinct bristle in line between the posterior intra-alar and supra-alar bristles. The

wing markings are somewhat similar to those of *octovittata* Williston, but the thorax is devoid of vittae and the cephalic and abdominal markings are different.

MINETTIA TINCTINERVIS, new species

Female.—Clay yellow, shining. Head opaque, face slightly shining, frons and face with slight white dusting; antennae and palpi yellow. Thorax not vittate; scutellum with a pair of deep black spots at apex. Abdominal tergites each with a narrow, centrally interrupted, black fascia on hind margin, broadest on sixth where it forms a large spot on each side. Legs yellow, apices of hind tibiae browned. Wings grayish hyaline, narrowly dark brown along costa from apex of auxiliary vein to apex of fourth, more broadly so on both cross veins, narrowly so on third and fourth veins from inner cross vein to apices, and on fifth vein from near base to apex. Halteres yellow.

Frontal bristles rubbed off in type, but the ocellar pair apparently small, postverticals situated well below edge of vertex, separated by about as great a distance as they are from ocelli; orbits poorly differentiated, anterior bristle rather far from eye; arista short pubescent; face flat; eye higher than long; cheek not as high as width of third antennal segment; lower margin of occiput with two strong bristles on each side. Thoracic bristling as in *evittata*, but without the bristle between the intra-alar and supra-alar bristles, and the anterior sternopleural is very small; scutellum broader than long, apex almost transverse, disk flattened; propleural bristle minute. Fore femur without anteroventral comb; hind femur without distinct anteroventral bristles. Wings rather narrow; last section of fourth vein slightly bent forward at apex, not over 1.5 as long as preceding section; inner cross vein at two fifths from apex of discal cell; outer cross vein at about half its own length from apex of fifth vein.

Length, 7 mm.

Type.—Higuito, San Mateo, Costa Rico (P. Schild.) Cat. No. 28449, U.S.N.M.

Distinguished from the other species with bipunctate scutellum by the almost bare arista, unspotted face, and narrowly clouded wing veins.

MINETTIA FUSCINERVIS, new species

Female.—Similar to *tinctinervis*, differing in having the scutellum without apical black spots, the tergal marks broader and more produced at their inner extremities, where they project forward angularly, the fifth tergite with the marks fused in center, forming a large triangular central spot, and not two lateral spots.

The postvertical bristles are closer together, and the inner cross vein of wing is a little nearer middle of the discal cell causing the last section of fourth vein to be very slightly longer than the preceding section.

Length, 7 mm.

Type.—Cayenne, French Guiana (W. Schaus). Cat. No. 28450, U.S.N.M.

This species appears to be very close to the genus *Melinomyia* Kertesz, the only difference being that in the latter there is a bristle near the upper anterior angle of the mesopleura which is absent in the present species. Structurally they are almost identical judging from Kertesz's figure and description.

MINETTIA BIPUNCTATA (Say)

This species is smaller than *evittata*, being about 4 mm. in length. The face is unspotted, the thorax is without vittae, the pair of apical spots on scutellum are small, the abdomen has very narrow dark hind margins to the tergites and a series of dark spots in center apically, while the wings are browned along costa as far back as third vein, beyond it apically, and both cross veins are brown clouded.

The frons is not one-third of the head width; the orbital bristles are long, the anterior one not far removed from eye; arista subnude; occiput strongly setulose. The anterior pair of the three pairs of postsutural dorsocentral bristles is very close to suture; both sternopleurals and the propleural bristle strong. Fore femur without anteroventral preapical comb. Outer cross vein of wing at two-fifths from apex of discal cell.

Originally described from Mexico and recorded from the West Indies. I have before me a specimen from Kingston, Jamaica.

MINETTIA GENISETA, new species

Female.—Testaceous yellow. Frons opaque, shining on orbits and triangle; face slightly shining, sides grayish yellow dusted. Thorax and abdomen immaculate. Wings grayish hyaline, cross veins almost imperceptibly clouded.

Frons at vertex a little less than one-third of the head width, widened anteriorly; orbital bristles long and strong, the anterior one farther from eye than posterior one; oceller bristles parallel, of medium length, situated behind level of anterior ocellus; postvertical bristles situated well below the rounded vertex, larger than ocellars; arista plumose; one or more of the postocular setulae at lower level of eye strongly developed, bristle like, the usual two strong bristles present on lower margin of occiput on each side. Postsutural dorsocentral bristles in three pairs, prescutellar acrostichals strong;

intradorsocentral setulae in about twelve series: posterior intra-alar rather short; propleural strong; anterior sternopleural bristle short; scutellum flattened above, slightly rounded in outline between the apical bristles; prosternum with a few hairs near front margin. Apical bristles on tergites quite distinct. Fore femur without anteroventral comb: mid tibia with four or five short bristles or setulae on posterior side; hind femur with one or two short preapical anteroventral bristles. Inner cross vein noticeably beyond middle of discal cell; last section of fourth vein about 1.5 as long as preceding section.

Length, 5 mm.

Type.—And one paratype, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28451, U.S.N.M.

This species and the next are distinguished from other unicolorous yellow species of the genus by the very well developed lower postocular bristle or bristles, and the presence of setulae or bristles on posterior side of mid tibia.

MINETTIA ASSIMILIS, new species

Male.—Very similar to the preceding species, but more distinctly shining, and with both cross veins quite noticeably clouded even to the unaided eye.

The intra-alar bristle is stronger and the small bristle caudad of the supra-alar is evident, the mid tibia has from two to four rather long strong posterior bristles, and the size is greater.

Length, 6–7 mm.

Type.—Male, Cano Saddle, Gatun Lake, Panama Canal Zone, May 6, 1923 (R. C. Shannon). Paratype, Venezuela. Cat. No. 28452, U.S.N.M.

A specimen from Trinidad Island has the costa a little browned but is evidently the same species.

MINETTIA TRISERIATA (Coquillett)

Subopaque, clay yellow. Apical three or four tergites each with three small round black spots, one on median line, the others at lateral curvature. Wings hyaline.

Ocellar bristles minute; orbitals strong; arista very short haired. Thorax with three pairs of postsutural dorsocentrals and one pair of prescutellar acrostichals, the intra-alar weak but distinct. Fore femur without anteroventral comb. Inner cross vein at middle of discal cell.

Length, 2.5 mm.

Originally described from Nicaragua. One specimen, Higuito, San Mateo, Costa Rica.

The above description is given to place upon record the essential features not in the original description. From this species *punctifer* Malloch differs in having the thoracic dorsum with brown dots at bases of the bristles and hairs. In other respects the two are very similar.

MINETTIA FRONTALIS Macquart

I identify as this species two specimens with the following characters: General color fulvous yellow. Frons with a velvety black triangular spot on each side between the shining orbits and eyes, the anterior margin of which is a little proximad of the anterior orbital bristle; orbits and triangle almost glossy, the latter extending almost to anterior margin, the interfrontalia on each side of it opaque brownish. Thorax immaculate. Abdomen with blackish hind margins to tergites, the apical two or three tergites each with a dark central mark. Apices of hind tibiae slightly browned. Costal margin dark brown, more broadly so from opposite inner cross vein to beyond apex of fourth vein, the dark color on apices of third and fourth veins slightly divided by a longitudinal hyaline streak inwardly; both cross veins broadly dark brown, and fifth vein faintly clouded.

Ocellar bristles short and fine; postverticals long; arista plumose. Thorax as in last species. Mid tibia with 3–5 short posterior bristles. Venation of wings as in last species.

Length 6–6.5 mm.

Localities, Tucurrique, and Carillo, Costa Rica (Schild and Burgdorf). I am not certain of the identity of this species because Macquart's description leads one to expect that his species has a short villose arista, and he gives 4 mm as the length. This is however the only species which I have seen from South America with two triangular black marks on the frons, and it agrees very well in other respects with the description of *frontalis*. An examination of the type of *frontalis* will determine if my identification is correct.

MINETTIA CHILENSIS (Schiner)

A shining fulvous yellow species, with apices of palpi black, and tarsi infuscated apically. Wings yellowish hyaline.

Arista pubescent; all frontal bristles, including the ocellars, long, and strong; postverticals below the rounded edge of the vertex; lower occiput with regular setulae and the usual two strong bristles on lower margin. Intradorsocentral setulae in six series; thoracic dorsocentrals as in *triseriata*. Fore femur without anteroventral comb; mid tibiae without posterior median bristles.

Length, 5 mm.

Angol, Chile, January, February, and March, 1925.

MINETTIA GEMINATA (Fabricius)

A very conspicuously marked yellow species, strikingly resembling *Alloclusia philippi* Rondani in thoracic and wing markings. Frons without a dark central line; face unspotted; cheek, center of sides of labrum, and apices of palpi, fuscous. Dorsum of thorax with two dark brown vittae which extend to apex of scutellum; pleura with two similar vittae, making six in all on thorax. Apices of abdominal tergites with black transverse line in center. Apices of all femora and of mid and hind tibiae, fore tibiae except bases, all of fore tarsi, and apices of mid and hind tarsi black. Wings marked as in figure 19.

Ocellars small; arista moderately long-haired. Postsutural dorsocentrals 3 or 4 pairs the anterior two pairs short; a distinct bristle in line between the intra-alar and supra-alar bristles. Fore femur without anteroventral comb.

Length, 6–7 mm.

Many specimens from Costa Rica.

Genus PSEUDOGRIPHONEURA Hendel

Although the genotype of *Pseudogriphoneura* Hendel and that of *Deceia* Malloch differ strikingly in habitus, the former being a very robust species and the latter quite slender, I hesitate to consider them as entitled to more than subgeneric separation. Apart from the general habitus *Deceia* has the ocellar bristles strong, while in *Pseudogriphoneura* these are very small and weak. Accepting these as subgenera we must perforce place all the subgenera accredited to *Deceia* in the recent paper by W. L. McAtee and the writer under *Pseudogriphoneura*. I have found several species of this subgenus in the United States National Museum and present a key for their separation herein.

KEY TO SPECIES

1. Legs entirely yellowish white; wings clear; apices of abdominal tergites testaceous yellow ---------- pallipes, new species.
   At least the femora black or dark gray ---------- 2
2. Wings with more than the apical half deep brownish fuscous; fore tarsi stouter at apex of first segment and on entire second than at base of first; apices of abdominal tergites not yellow ---------- cormoptera Hendel.
   Wings hyaline, without dark cloud ---------- 3
3. Apices of abdominal tergites rather broadly yellowish; thorax quite noticeably quadrivittae with brown ---------- variata Hendel.
   Apices of abdominal tergites not noticeably yellow; thorax without apparent brown vittae ---------- hyalipennis, new species.

PSEUDOGRIPHONEURA CORMOPTERA Hendel

This species has a great resemblance to some of those in *Griphoneura*, the similarity being heightened by the very distinctly marked wings.

I have before me 4 specimens from Juan Vinas, Costa Rica (P. Schild).

This species probably influenced Hendel to use the above generic name for the group.

PSEUDOGRIPHONEURA VARIATA Hendel

Black, densely lead grey pruinescent. Antennæ brownish yellow; a dark mark on cheek below middle of eye; palpi brown. Thoracic dorsum with two faint, narrow brown submedian vittae, and between these and lateral margins a similar less distinct brownish vitta; area surrounding prothoracic spiracle rather conspicuously white dusted. Abdomen colored as thorax, but the tergites with broad, testaceous yellow hind margins. Legs white, coxae and femora, except extreme apices of latter, black, fore tarsi sometimes dark on apical two or three segments. Wings hyaline. Halteres yellow.

Both pairs of fronto-orbital bristles strong, curved backward; ocellars very small; arista plumose. Prescutellar arostichals strong. Inner cross vein at middle of discal cell; last section of fourth vein from 2 to 2.75 as long as preceding section; outer cross vein at a little less than its own length from apex of fifth.

Length, 4–5 millimeters.

Higuito, San Mateo, Costa Rica (P. Schild).

This is the species described as *Sapromyza varia* by Coquillet. I consider it is the same as *P. cinerella* Hendel.

PSEUDOGRIPHONEURA PALLIPES, new species

Female.—Differs from the above in having the frons darker grey, face yellowish on sides and above, antennae paler; thorax whitish grey in center and purplish grey on lateral third on each side; legs including coxae stramineous.

Structurally similar to above, but the last section of fourth vein is barely more than twice as long as preceding section in female.

Length, 5.5 millimeters.

Higuito, San Mateo, Costa Rica (P. Schild).

Type.—Cat. No. 28453, U.S.N.M.

PSEUDOGRIPHONEURA HYALIPENNIS, new species

Male and female.—Similar to *variata* but darker in color, and with the dark thoracic vittae absent or much less distinct than in that species. The abdomen has no yellow apices to tergites, and the pale parts of the legs in the male are more yellow than white.

There are no noticeable structural distinctions externally.

Length, 4.5–5 mm.

Type.—Male, allotype and 5 paratypes, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28454, U.S.N.M.

Subgenus MELANOMYZA Malloch

PSEUDOGRIPHONEURA (MELANOMYZA) LATERALIS, new species

Male and female.—Shining black, antennae yellow, legs and halteres stramineous; anterior half of each orbit opaque velvety black, remainder of frons glossy black; pleura opaque; scutellum shining. Wings slightly grayish, outer cross vein very faintly clouded.

Anterior orbital bristle about half as large as posterior one; ocellars microscopic; antennae stout, third segment tapered a little apically, barely twice as long as its basal width; arista plumose; face convex; cheeks linear. Thorax with two pairs of strong dorso-centrals; prescutellar acrostichals absent. Inner cross vein distinctly beyond middle of discal cell; outer cross vein at more than its own length from apex of fifth vein; last section of fourth vein nearly four times as long as preceding section.

Length, 3 mm.

Type.—Male, allotype, and one male and one female paratype, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28455, U.S.N.M.

The only species known to me which has the sides instead of the center of frons velvety black.

PSEUDOGRIPHONEURA (MELANOMYZA) ALIENA, new species

Male.—Head black, frons with interfrontalia opaque velvety from anterior ocellus to antennae, the orbits and ocellar region glossy; face yellow; antennae yellow, third segment back except at base; arista fuscous; palpi yellow. Thorax black, shining, greasy in type; pleura opaque, black, upper parts of mesopleura and sternopleura whitish pruinescent. Abdomen black. Legs including coxae stramineous, fore femora with a faint dark mark near apices on posterior side. Wings greyish, a slight dark cloud near apex of second vein and disk of wings slightly brownish. Halteres dusky yellow.

Ocellar and postvertical bristles minute; orbital bristles weak, the front pair especially so; antennae fully as long as height of head; basal segment as long as second, third four times as long as broad, not very slender; arista long haired above, short haired below; face slightly receding below; cheek linear. Only one pair of distinct dorsocentrals present, and no prescutellar acrostichals; pleural bristles weak. Abdomen long and slender. Legs slender, longer than usual, the preapical tibial bristle lacking. Wings about three times as long as wide, inner cross vein at middle of discal cell, last section of fourth vein nearly three times as long as preceding section.

Length, 2.75 mm.

Type and 2 paratypes.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28456, U.S.N.M.

A very slender species, with the habitus of an Anthomyzid, but evidently an aberrant *Melanomyza*, lacking the tibial bristle and anterior pair of dorsocentral bristles. Possibly entitled to subgeneric segregation.

PSEUDOGRIPHONEURA (NEODECIA) MARMORATA, new species

Female.—Head black, densely gray pruinescent, center of frons faintly brownish, a spot between each antenna and eye and a narrow cross band above mouth margin brown. Thorax concolorous with head, with three broad dark brown dorsal vittae, the median one extending over disk of scutellum, a brownish mark below humeral angle and another along lower margin of mesopleura. Abdomen densely gray pruinescent, with three large irregular dark brown spots on anterior half of each tergite and quite large dots of same color at bases of the bristles along hind margins of tergites which connect with the large anterior markings. Coxae and femora fuscous, trochanters paler, tibiae white, both extremities black; tarsi white, apices of fore pair black. Wings yellowish, with a dark cloud between apices of auxiliary and first veins and fainter clouds on both cross veins. Halteres yellow.

Frons flat, a little over one-third of the head width, and broader than long; ocellar bristles strong; anterior orbital a little shorter than posterior one; face almost vertical, flat; cheek narrow; third antennal segment longer than wide, quite noticeably pilose; arista plumose. Thorax with two pairs of dorsocentrals and one pair of strong prescutellar acrostichals. Inner cross vein a little before middle of discal cell: last section of fourth vein nearly twice as long as preceding one.

Length, 3 mm.

Type and six paratypes.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28475, U. S. N. M.

The strikingly marked abdomen of this species, readily distinguishes it from *cineracea* Coquillett, the genotype and only recorded species of the subgenus. The eyes in *marmorata* are not much narrowed below as in *cineracea*, and all the species in *Pseudogriphoneura*, but it appears to me unneccessary to erect a subgenus for its reception at this time. There are a number of species before me from South America which agree with the above one in the bristling of the thorax, a character they have in common with all the segregates of *Pseudogriphoneura*.

Genus SAPROMYZA Fallén

SAPROMYZA ORNATA Schiner

This is a rather aberrant species, of a general testaceous yellow color, the frons entirely shining, face with a pair of submedian vertical dark lines, the abdomen with a series of dorsocentral spots and larger transverse lateral marks black, the latter least distinct on tergite 3 and most distinct on tergite 4; fore femora darkened at apices on anterior surface. Wings yellowish, outer cross vein and apex faintly darker.

Anterior orbital bristle rather small, far from eye; ocellars practically absent; arista short haired. Thorax with two pairs of dorsocentral bristles and one pair of prescutellar acrostichals; anterior sternopleural very small; scutellum convex. Fore femur without anteroventral comb. Inner cross vein at middle of discal cell; penultimate section of fourth vein fully three-fifths as long as ultimate one.

Length, 5.5–6 mm.

Two specimens, Higuito, San Mateo, Costa Rica (P. Schild).

SAPROMYZA UMBROSA Loew

Specimens of this North American species are before me from Higuito, Costa Rica, and Panama Canal Zone, which differ little from those obtained in the vicinity of Washington, D. C.

SAPROMYZA NIGROAPICATA, new species

Female.—Frons brown, yellow across anterior margin, ocellar spot and orbits fuscous, face brownish testaceous, parafacials white pruinescent, a dark spot between base of each antenna and eye; occiput black, upper central third yellowish brown, entire head shining; basal two antennal segments black, third missing in type; palpi fuscous; cheeks yellow. Thorax and scutellum shining black above, sides of mesonotum becoming yellowish, pleura testaceous yellow, darkened above. Abdomen brownish testaceous, shining, paler on venter. Legs yellow testaceous, apices of all femora conspicuously but narrowly blackened, extreme bases of tibiae slightly darkened. Wings hyaline. Halteres yellow.

Ocellar bristles short, postverticals long, widely separated; anterior orbital much shorter than posterior one; frons without surface hairs; eye narrowed below; cheek linear. Thorax with two pairs of dorsocentrals and one strong pair of prescutellar acrostichals; intradorsocentral hairs in about eight series; scutellum elongate, flat above, sides rounded or bevelled off, bristles equal. Fore

femur without anteroventral comb; fore and hind tibiae with very short preapical bristle. Inner cross vein at middle of discal cell, outer at less than its own length from apex of fifth vein; last section of fourth vein three times as long as preceding section.

Length, 3.5 mm.

Type.—Barro Colorado, Panama Canal Zone, July 1, 1923 (R. C. Shannon). Cat. No. 28457, U.S.N.M.

The shining black thoracic dorsum and yellow legs with black tipped femora readily distinguish this from any known species of the genus.

Subfamily PERISCELINAE

This subfamily, as mentioned under the family discussion, is distinguished by the presence of but one orbital bristle, the divergent postvertical bristles, and the incomplete auxiliary vein of the wings.

So far only one of the genera has been recorded from the Old World but all four occur on this side of the Atlantic.

KEY TO GENERA

1. Auxiliary vein without indication of a forward bend at apex; face conspicuously protruded below 2
   Auxiliary vein with a distinct forward curvature at apex; face not conspicuously protruded below 3
2. Face conspicuously flattened, more or less shield shaped below antennae, the flat part bare, sides hairy ..... **Scutops** Coquillett.
   Face evenly convex, entire surface hairy ..... **Neoscutops**, new genus.
3. Face flattened but not conically produced below; space between bases of antennae about as wide as that between either antenna and eye; frons much over half of the head width; vibrissae small but distinct. **Sphyraperiscelis** Sturtevant.
   Face not flattened; space between bases of antennae linear; frons about half the head width; vibrissae not developed ..... **Periscelis** Loew.

SCUTOPS FASCIPENNIS Coquillett

This species appears to be not uncommon in Costa Rica from whence I have seen some specimens collected by P. Schild.

I have figured the head (fig. 5) and the wing (fig. 3) of this species to show the distinction between it and the new species included in this paper.

SCUTOPS MACULIPENNIS, new species

Male and female.—Head yellowish white, with gray pruinescence, frons with a large black mark extending from vertex to beyond orbital bristle on each side, the triangle fuscous; face with a dark median stripe which has lateral branches about middle and is dilated at apex of the flattened area, below the latter there is a transverse black stripe from eye to eye; antennae whitish, second segment black, third darkened above; palpi broadly black at apices. Thorax black, dorsum with dense grey pruinescent markings as in figure 6, hu-

meral angles yellowish; pleura shining black, yellowish in middle and below posteriorly, with a median grey pruinscent vitta. Abdomen shining black, with a pale yellowish spot on each lateral incurved portion of each tergite, which may extend on to disk of tergite. Legs pale yellow, coxae and femora largely or entirely black, all tibiae with two small annuli, all tarsi with the apical three segments black. Wings black, with many hyaline dots and spots (fig. 4). Halteres whitish.

Postverticals strong; ocellars long and parallel, in line with anterior ocellus and wider at base than width across posterior ocelli; the single orbital bristle long; one or two of the long lateral facial hairs situated on anterior edge of the flat area. Thorax with two pairs of postsutural dorsocentrals and one pair of prescutellar acrostichals; scutellum bare or disk, with four marginal bristles. Legs stout, preapical tibial bristle not distinguishable. Wing venation as in figure 4.

Length, 3–4 mm.

Type.—Female, allotype and paratypes, Mexico City, Mexico, January 1924. Cat. No. 28458, U.S.N.M.

The flattened part of face in this species is more broadly rounded below than in *fascipennis*, being almost transverse while in the latter it is rather obtusely pointed, presenting a subtriangular appearance. The wing markings and venation as well as the coloration of the head, thorax, and legs are very different in the two species, which are all that are now known as belonging to the genus.

NEOSCUTOPS, new genus

Generic characters.—Head (fig. 7) similar to that of *Scutops*, but the face is evenly convex, haired on entire surface, two of the hairs near middle of disk longer than the others, and there is a slight but evident central protuberance on middle of lower margin; frons about half of the head width, depressed in front, with one pair of orbital bristles, the anterior ocellus hardly more than its own length from vertex, laterals on vertex; ocellar bristles long, slightly convergent; postverticals divergent; arista plumose; vibrissae absent. Thorax in type covered with threadlike growth of mold or fungus, so that it is not possible to definitely decide the armature, but there appears to be but one pair of dorsocentrals and one pair of long scutellars present and no mesopleurals nor sternopleurals. Wing as in figure 8.

Genotype.—*Neoscutops rotundipennis*, new species.

NEOSCUTOPS ROTUNDIPENNIS, new species

Female.—Head testaceous yellow, shining, frons, upper part of face, and occiput, black. Thorax except humeri shining black, the

latter yellow. Abdomen black. Legs black, tibiae and tarsi yellow, hind tibiae more or less fuscous. Wings smoky. Halteres dark.

A robust species. Thorax fully as wide as long, scutellum twice as wide as its length at center. Legs stout, fore femur with strong posteroventral bristles; fore tibia with short posteroventral setulae.

Length, 1.75 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28459, U. S. N. M.

In this genus the wing venation shows an approach to that of *Steganopsis latipennis* Coquillett.

Family AGROMYZIDAE

This family is distinguished from its allies by the presence of vibrissae, the postvertical bristles being divergent, the basal cells of wing both present, and the auxiliary vein very close to first vein or fused with it.

In this paper I describe one new genus and three new species.

SCHILDOMYIA, new genus

Generic characters.—Of the same habitus as *Odinia* Robineau-Desvoidy, but differing as follows: The divergent postvertical bristles much closer together, situated on edge of vertex, and more widely separated from posterior ocelli than length of ocellar triangle, the latter elevated; frontal lunule sparsely haired; orbital bristles in three pairs as in *Odinia*, the anterior pair incurved; an upwardly and forwardly directed bristle well above margin of cheek, not on margin as in *Odinia*. Only four pairs of dorsocentral bristles present, one pair presutural; posterior intra-alar present; scutellum haired on disk. Fourth wing vein not deflected apically, the first posterior cell therefore not widened, but slightly narrowed, apically, the costa not obviously discontinued at apex of third vein, but continued rather noticeably to apex of fourth. Hind femora not abnormally thickened, unarmed on anteroventral surface near apex.

Genotype.—*Schildomyia vittithorax*, new species.

KEY TO SPECIES

1. Arista long haired, plumose; prescutellar acrostichals absent; propleural bristle not duplicated; scutellum with a large dark brown spot on each side which cover entire lateral margins and almost meet in center of disk, leaving only the base and apex gray in center; orbits with dark spots ..... **vittithorax**, new species.

   Arista pubescent; prescutellar acrostichals present; propleural bristle duplicated; scutellum with the lateral margins pale 2

2. No dark spots at bases of the frontal orbital bristles; antennae yellow. **brevihirta**, new species.

   A dark spot at base of each orbital bristle; antennae largely black. **punctifrons**, new species.

SCHILDOMYIA VITTITHORAX, new species

Female.—Head clay colored, with the following dark brown marks. A streak over ocelli to vertex, interfrontalia except the triangle, a spot at base of each orbital bristle, one between antennal base and eye, and a large portion of each side of occiput; antennae fuscous, base of third segment on inner side yellowish; palpi testaceous yellow. Thorax testaceous, densely pale gray pruinescent, with three broad chocolate brown vittae, the median one not extending to posterior margin except as a narrow point, a dark spot at base of each dorsocentral bristle, a large dark mark on each side of scutellum, a fainter vitta on middle of mesopleura and pteropleura and a mark on sternopleura. Abdomen testaceus, with sides of disk of first visible tergite blackish brown, second, third, and fourth tergites almost black, with pale gray pruinescent markings on hind margins. Legs yellow testaceous, femora with one, tibiae each with two faint dark annuli. Wings hyaline, cross veins not distinctly clouded. Halteres yellow.

Frons longer than wide, a rather noticeable group of short setulose hairs at bases of the two anterior orbital bristles; arista plumose; cheek nearly half as high as eye, the latter longer than high. Discal thoracic hairs weak; basal pair of scutellar bristles about half as long as apical pair. Outer cross vein at its own length from inner and two-thirds that length from apex of fifth vein; last section of fourth vein about four times as long as preceding section.

Length, 3.5 mm.

Type and 1 paratype.—Higuito, San Mateo, Costa Rica (P. Schild). Paratype, Cano Saddle, Gatun Lake, Panama Canal Zone, August 5, 1923 (R. C. Shannon). Cat. No. 28460, U.S.N.M.

SCHILDOMYIA BREVIHIRTA, new species

Male.—Differs from the preceding species in having no dark spots at bases of the frontal orbital bristles and antennæ, in having two faint dark spots above mouth margin on face, the median thoracic vitta is narrowed on posterior third, but does not terminate in a narrow point, the lateral vittæ are narrower and do not extend to margins.

The arista is very short haired. Prescutellar pair of acrostichal bristles present. Outer cross vein at about half its own length from inner, last section of fourth vein bent forward a little apically, as long as antepenultimate section and six or seven times as long as penultimate.

Length, 4.5 mm.

Type.—Cano Saddle, Gatun Lake, Panama Canal Zone, August 5, 1923. Paratype, Monto Lirio, Panama, April 6, 1923 (R. C. Shannon). Cat. No. 28461, U.S.N.M.

SCHILDOMYIA PUNCTIFRONS, new species

Male.—Head much as in *vittithorax*, but the frons is rufous in front centrally, the face is fuscous, with dense gray dusting in middle, not with a black central mark, the cheeks are largely dark brown, and the antennae have the second segment and a spot on outer and another on inner side of third segment blackish. Thoracic dorsal markings as in figure 16; pleura with the following chocolate colored markings: a line along upper margin, a vitta on middle of mesopleura and pteropleura, interrupted on middle of former, another along upper margin of sternopleura, and the lower half of sternopleura. Abdomen black, hind margins of tergites narrowly yellow, becoming broader laterally. Coxae and femora almost entirely, and two annuli on each tibia, fuscous. Cross veins of wings rather noticeably clouded.

Structurally similar to *brevihirta*, but the cross veins are more widely separated, the fourth vein is less distinctly curved forward apically, and the size smaller.

Length, 3.5 mm.

Type.—Higuito, San Hateo, Costa Rica (P. Schild). Cat. No. 28462, U.S.N.M.

I am a little doubtful of the sex of this specimen and, as it is rather badly covered with filamentous growth, do not desire to tamper with it to determine whether it is a male or not, though I suspect that it is of that sex.

Family DROSOPHILIDAE

DROSOPHILA PANAMENSIS, new species

Female.—Head clay-yellow, densely yellowish pruinescent, ocellar spot, interfrontalia on each side of triangle, upper part of occiput, upper extremities of frontal orbits, cheek below middle of eye, and sides of labrum dark brown; antennae and palpi yellow. Thoracic dorsum chocolate brown, with lateral margins and four vittae in front of suture yellowish gray pruinescent, only the submedian pair extending beyond suture, behind suture there are five similar vittae, the median one least conspicuous; pleura concolorous with mesonotum, with a pale vitta over prothoracic spiracle and another from above fore coxa to below haltere; scutellum dark brown, with a grayish spot at apex and one on each side at base; postnotum dusky yellow. Abdomen testaceous yellow, each tergite with a centrally interrupted dark brown fascia on hind margin which extends to extreme lateral margins. Legs dark brown, fore pair missing in type, apices of femora, a basal and median annulus on tibiae, and all of tarsi of mid and hind pairs yellow. Wings brownish, most

noticeably so along costa, at apex of first vein, and on cross veins. Halteres yellow.

Eyes with minute stiff hairs; frons over one-third of the head width; ocellar and postvertical bristles strong; both reclinate orbitals distinct, the anterior one about midway between posterior and proclinate bristle, the latter almost at middle of frons; antennae distinctly separated at base; carina large and wide, with a slight median sulcus, ending a little above mouth margin; two vibrissae present; cheek as high as width of the dilated palpi. Thorax normal, intradorsocentral setulae in about twelve series. Abdomen stout. Legs normal. Wing as in figure 9.

Length, 4 mm.

Type.—Barro Colorado, Panama Canal Zone, July 16, 1923 (R. C. Shannon). Cat. No. 28463 U.S.N.M.

The only species of the genus known to me in which the first posterior cell of the wing is distinctly narrowed at apex.

DROSOPHILA PILIFACIES, new species

Female.—Head testaceous yellow, orbits and frontal triangle gray dusted, interfrontalia reddish orange, brownish along orbits; antennae testaceous, third segment brown; labrum fuscous. Thorax subopaque, brownish testaceous, dorsum with four broad dark vittae, the submedian pair most distinct; scutellum dark brown on disk, yellowish on sides; pleura largely fuscous, paler on sutures. Abdomen shining fuscous brown, yellowish on each side of each tergite along anterior margins. Legs brownish yellow, femora and coxae darkest. Wings brownish hyaline. Halteres with the knobs yellow.

Ocellar bristles long, parallel; postverticals long; anterior reclinate bristle short, situated behind the proclinate bristle, the latter distinctly proximad of middle of frons; interfrontalia almost bare; face with a well-developed central carina which is rather sharply rounded above and tapered off on lower half of face, the central part of latter below carina with minute erect hairs; cheek narrow; eyes stiff haired; vibrissae duplicated. Thorax with about six series of intradorsocentral setulae, two pairs of long dorsocentrals, and no prescutellar acrostichals; anterior sternopleural very short. Abdomen stout. Legs normal. Costa with a fine setula at apex of first vein, not deeply incised there; first costal division less than one-third as long as second, the latter less than twice as long as third; inner cross vein at about two-fifths from base of discal cell; fourth vein not bent forward apically.

Length, 2 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28464. U.S.N.M.

This is the only species I have seen in which there are hairs on center of face. I do not consider this character as sufficient to entitle its possessor to removal from the genus *Drosophila*.

DROSOPHILA SPINICAUDA, new species

Female.—Head pale clay yellow, upper occiput, frons except anteriorly on sides, lower margin of cheeks, and face except carina, pale brownish; antennae pale; palpi pale brownish. Thorax colored as head, dorsum more brownish, with three dark vittae, a fuscous brown mark along hind side of humeral callosity, and a black spot in front of supra-alar bristle above wing base; scutellum pale brown, yellow on basal lateral angles; large dark brown marks on mesopleura, sternopleura, and pteropleura. Abdomen with hind margins of tergites 1 to 4 dark brown, the dark color extending the whole length of tergites in center, tapered off on sides, and not connected with the dark mark on extreme lateral edges; fifth tergite with a triangular dark mark on hind margin. Legs clay yellow, femora at bases, and a basal and apical annulus on each tibia brownish. Wings faintly browned. Halteres black.

Head in profile as in figure 12; eyes hairy; frons widened above; facial carina prominent, evenly rounded, two-thirds of the face length; third antennal segment pilose. Thorax normal; intradorsocentral hairs in 8–10 series; prescutellar acrostichals absent; scutellum flattened; both sternopleurals distinct. Legs normal. Second costal division fully three times as long as second and over 1.5 as long as third; second vein straight to apex; inner cross vein a little over one-third from base of discal cell; outer cross vein about 1.5 its own length from apex of fifth vein; last section of fourth vein fully 1.5 as long as preceding one; ovipositor in side view as in figure 11.

Length, 3 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28465, U.S.N.M.

This species is closely related to *annularis* Sturtevant, but differs in venation, color, and in having the facial carina nonsulcate.

DROSOPHILA NIGRICOSTA, new species

Female.—Tawny yellow, slightly shining. Abdomen fuscous on dorsum. Legs yellow. Wings hyaline, marked with fuscous as in figure 10. Halteres yellow.

Eyes sparsely haired; frons convex; ocellar and postvertical bristles large; lower reclinate bristle small, noticeably proximad of proclinate one; face with a slight carina just below bases of antennae; cheek linear; one vibrissa only, which is situated above

mouth margin, the latter rounded. Thorax with normal bristling, intradorso-central setulae in about 8 series; both sternopleurals distinct; legs normal.

Length, 2 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28466, U.S.N.M.

This species resembles some of those in *Chymomyza*, but despite the position of the lower reclinate bristle is a true *Drosophila*.

DROSOPHILA BICOLORIPES, new species

Male.—Similar to *nigricosta*, differing in having the costal cloud fainter, and absent in marginal cell except narrowly along costal vein and at base and apex; the outer cross vein has a conspicuous dark brown cloud over it, and the tip of wing is faintly clouded. The fore femora except base, all of fore tibiae and the fore metatarsi are black, the apical four segments of fore tarsi whitish.

Head bristles mostly rubbed off but the scars indicate that they are similar to those of last species. Inner cross vein at about two-fifths from base of discal cell, second and third costal divisions subequal, outer cross vein nearer to apex of fifth vein than in *nigricosta*.

Length, 2 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28467, U.S.N.M.

AMIOTA STEGANOPTERA, new species

Female.—Shining black, lower half of face, a spot on each humeral angle, and one on each pleura below wing base, milk white; basal visible abdominal tergite in center, and second narrowly at base, yellow. Bases of antennae, and the palpi yellowish. Legs and halteres testaceous yellow. Wings hyaline.

Orbital bristles on moderate length; postvertical bristles microscopic. Thorax normal, scutellum convex, rounded in outline, the margin thick, bristles equal in length. Wing venation as in figure 18: third costal division with some widely separated short wart-like spines on under surface as in *Stegana* and *Leucophenga*.

Length, 2.5 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28468, U.S.N.M.

No other species of the genus which I have seen has the warlike spines on costa, the character being previously recorded only in *Stegana* and *Leucophenga*, and the color of the abdomen is distinct from that of any other described species. The species might be separated from *Amiota*, at least subgenerically, but there is nothing to be gained by such a course as the other characters are identical with those of typical species of that genus.

LEUCOPHENGA UNIFASCIVENTRIS, new species

Female.—Head, thorax and legs fulvous yellow, abdomen black, with a broad fulvous yellow fascia covering second and third visible tergites. Wings hyaline, marked as in figure 13.

Postvertical bristles microscopic; orbital bristles long; cheek linear. Wing venation as figure 13.

Length, 2 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28469, U.S.N.M.

Distinguished from any known American species by the unifasciate abdomen. Several Oriental and Australian species have abdominal markings like this one.

LEUCOPHENGA ACUTIPENNIS, new species

Female.—General color as in last species, the palpi and disk of scutellum darker, abdomen marked as in figure 17, the outer black spot on each side on the incurved lateral margin of tergite so that it is not visible from above. Wings as in figure 14.

Structurally similar to last species, the palpi but little dilated, but the wings are quite acute at apices and the position of the outer cross vein is different.

Length, 3 mm.

Type.—And one paratype, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28470, U.S.N.M.

LEUCOPHENGA TRIPUNCTIPENNIS, new species

Female.—Similar to *unifasciventris*. First visible tergite yellow, second with 3 large black spots, third with 5, the one on each lateral margin invisible from above, fourth tergite with apparently 5 spots, the median one linear, fifth with at least one on each side, but type in poor condition to see details. Wings as in figure 15.

Length, 3 mm.

Type.—Higuito, San Mateo, Costa Rica (P. Schild). Cat No. 28471, U.S.N.M.

LEUCOPHENGA ARGENTIVENTRIS Kahl

In his original description of this species Kahl states that the "apical segments [of abdomen] show some blackish or dusky in the specimen, but this may be caused by deterioration." In the specimen before me there are five black spots on fourth and fifth tergites, the outer one of each series on each tergite not visible from above. The silvery white dusting on thorax and abdomen, visible when the specimen is viewed from in front, as well as the conspicuously marked wings, which are somewhat similar to those of *acutipennis*, distinguish this species from its congeners.

Locality.—Higuito, San Mateo, Costa Rica (P. Schild).

LEUCOPHENGA FRONTALIS (Williston)

This species has the wings without distinct dark markings, only the apex of first vein being blackish.

I consider that *ornativentris* Kahl is a synonym.

Locality.—Higuito, San Mateo, Costa Rica (P. Schild.)

Hendel has erected the genus *Oxyleucophenga* for the reception of one South American species, *undulata* Hendel. The only distinction between this genus and *Leucophenga* is that the wings are more pointed in the former. If the genus is to be maintained then *acutipennis* above described belongs to it, but I am of the opinion that the genus is invalid, there being all degrees of variation in the acuteness of the wings. I place *Oxyleucophenga* as a synonym of *Leucophenga.*

CLASTOPTEROMYIA MACULIPENNIS, new species

Female.—Head testeceous, shining, frons above and upper occiput darkened, ocellar spot blackish. Thorax brownish testaceous, shining, abdomen similarly colored, but darker. Legs stramineous. Wings fuscous, with the following hyaline marks: a transverse band close to base, a transverse mark about its own width beyond apex of first vein, which extends from costa to fifth vein, reaching the latter about as far from apex of discal as length of outer cross vein, a similar spot across middle of cell behind fifth vein, one across middle of second posterior cell, and one extending across wing from apex of second vein to fourth vein near middle of its apical section.

Ocellar bristles long; lower reclinate bristle microscopic; face not carinate; cheek linear; one vibrissa on each side. Both pairs of dorsocentrals distinct; prescutellar acrostichals absent; scutellum convex, bristles subequal. First costal division a little over one-fourth as long as second, the latter not 1.5 as long as third; veins 3 and 4 divergent at apices, section of costa between their apices fully half as long as the one before it; last section of fourth vein not twice as long as penultimate section; outer cross vein at about its own length from apex of fifth vein.

Length, 1.75–2 mm.

Type.—And one paratype, Higuito, San Mateo, Costa Rica (P. Schild). Cat. No. 28472, U.S.N.M.

This is the only species of the genus known to me which has the wings with conspicuous spots.

Drosophila superba Sturtevant I consider belongs to this genus, and is distinguished from the above species in having only three hyaline marks on the wing, and but one pair of distinct dorsocentral bristles.

CLASTOPTEROMYIA LONGIPENNIS, new species

Male.—Head testaceous yellow, the face more whitish; ocellar spot fuscous. Thorax more brownish yellow above, pleura much paler, the former with faint traces of two vittae and a mark on each lateral margin behind suture; pleura with two broad dark brown vittae, one on middle of mesopleura and the other on upper margin of sternopleura. Abdomen fuscous. Legs clay yellow. Wings smoky brown. Halteres pale.

Ocellar bristles long; postvertical pair weak; lower reclinate orbital bristle very small, almost in transverse line with the strong proclinate bristle; eyes almost bare; face with a very slight central carina above; only one strong vibrissa. Thorax with but one distinct pair of dorsocentrals, the intradorsocentral hairs in about 10 series. Legs long and slender, fore femur without a comb. Wings elongate, anal angle not developed, general structure similar to that of *superba* Sturtevant; inner cross vein a little over one-fourth from base of discal cell; second costal division fully four times as long as first; third about 1.25 as long as first; first posterior cell a little widened at apex; penultimate section of fourth vein about four-fifths as long as ultimate; outer cross vein about 1.5 its own length from apex of fifth vein.

Length, 3 mm.

Type.—Male, Cat. No. 28473, U.S.N.M. Higuito, San Mateo, Costa Rica (P. Schild).

The general coloration, habitus, and elongate wings give this species much the appearance of a *Curtonotum*. It is possible that, with *superba*, this species might be subgenerically sparated from *Clastopteromyia* on the basis of the single pair of dorsocentral thoracic bristles and the lack of a well developed anal angle to the wing, but further study of more material and information as to the habits of the larvae is desirable before such a course is resorted to.

EXPLANATION OF PLATES

PLATE 1

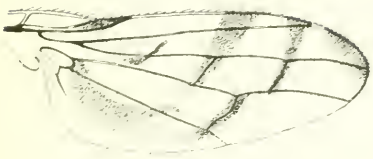
Details of Sapromyzidae and Drosophilidae

FIG. 1, *Xenopterella obliqua*, wing.
2, *Minettia evittata*, wing.
3, *Scutops fascipennis*, wing.
4, *Scutops maculipennis*, wing.
5, *Scutops fascipennis*, head from the side.
6, *Scutops maculipennis*, thoracic markings.
7, *Neoscutops rotundipennis*, head from the side.
8, *Neoscutops rotundipennis*, wing.
9, *Drosophila panamensis*, wing.

PLATE 2

Details of Sapromyzidae, Drosophilidae, and Agromyzidae

FIG. 10, *Drosophila nigricosta*, wing.
11, *Drosophila spinicauda*, ovipositor from the side.
12, *Drosophila spinicauda*, head from the side.
13, *Leucophenga unifasciventris*, wing.
14, *Leucophenga acutipennis*, wing.
15, *Leucophenga tripunctipennis*, wing.
16, *Schildomyia punctifrons*, thoracic dorsal markings.
17, *Leucophenga acutipennis*, abdominal dorsal markings.
18, *Amiota steganoptera*, wing.
19, *Minettia geminata*, wing.
20. *Neominettia contigua*, wing.



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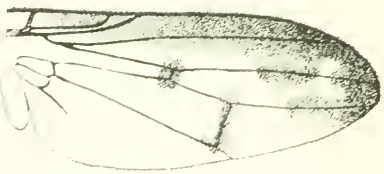

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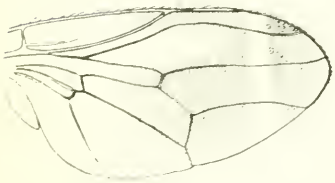

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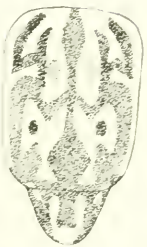

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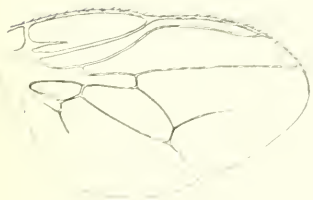

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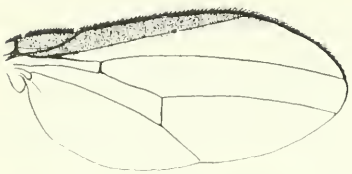
9

DETAILS OF SAPROMYZIDAE AND DROSOPHILIDAE

FOR EXPLANATION OF PLATE SEE PAGE 34



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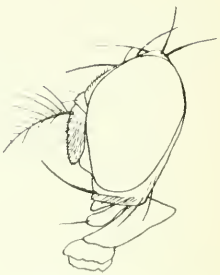

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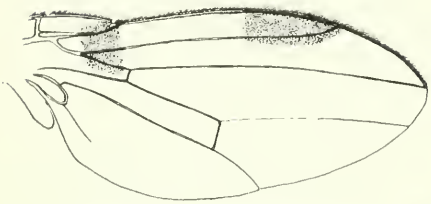

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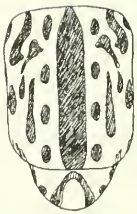

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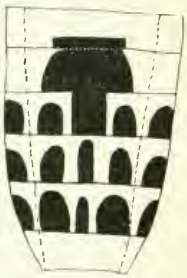

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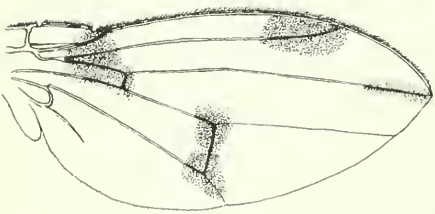

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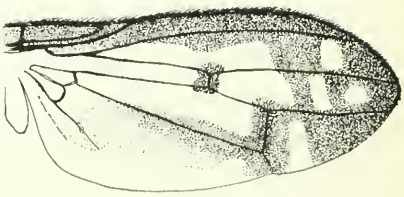

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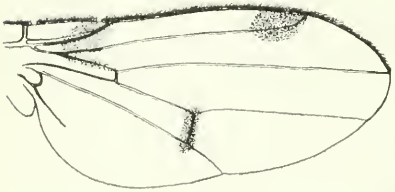

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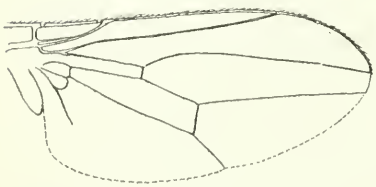

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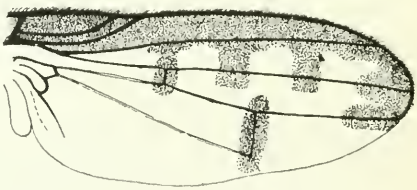

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DETAILS OF SAPROMYZIDAE, DROSOPHILIDAE, AND AGROMYZIDAE

FOR EXPLANATION OF PLATE SEE PAGE 35

DESCRIPTIONS OF NEW WEST INDIAN LONGICORN BEETLES OF THE SUBFAMILY LAMIINAE

By Warren S. Fisher

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The following descriptions of 4 new genera, 26 new species, and 3 varieties are the results of a study of the material of this subfamily of the Cerambycidae from the West Indies contained in the collection of the United States National Museum. In connection with this study material from the American Museum of Natural History has been examined. The descriptions of the new species received from the American Museum (with the exception of one), have been published in a paper issued by that institution.[1]

LIOSYNAPHAETA, new genus

Mandibles moderately large and rather thick at base. Head broad, feebly concave between the antennal tubercles, the front wider than long, and the cheeks rather short. Antennae shorter than body in female, slightly longer than body in male, and rather strongly ciliate beneath; first joint moderately robust, with a distinct open cicatrix at apex, subequal in length to the third joint, which is slightly longer than the fourth, the following joints gradually diminishing in length, with the last joint feebly bent near apex in the male. Eyes large, rather coarsely granulated, and nearly divided, the lower lobes as long as wide. Pronotum wider than long, uneven on disk, and tuberculate at the sides. Scutellum somewhat triangular and broadly rounded behind. Elytra rather short, broad, feebly convex above, without lateral carinae, and with the humeri strongly developed. Legs moderately long, and subequal in length; femora gradually enlarged near middle; intermediate tibiae not grooved; tarsi short, the anterior pair slightly broader than the middle and posterior ones, and the claws divaricate. Mesosternum horizontal, arcuately emarginate posteriorly, and vertical in front, with the anterior angle projecting; intermediate coxal cavities open. Prosternal process rather narrow between the coxae, strongly arcuate, and nearly vertical posteriorly.

Genotype.—Liosynaphaeta balloui, new species.

[1] American Museum Novitates, No. 174, 1925, pp. 1–16.

This genus is allied to *Synaphaeta* Thompson, but differs from it in having the cheeks shorter, the head only feebly depressed between the antennal tubercles, the eyes not wider than long, and more coarsely granulated, the antennae shorter, not as strongly ciliate, and the first joint subequal in length to the third, the elytra not flattened above, more even, regularly convex at the sides and without lateral carinae.

LIOSYNAPHAETA BALLOUI, new species

Male.—Form elongate, broad, regularly convex above, and densely, irregularly variegated with moderately long, recumbent, cinereous, and ocherous pubescence, forming no regular designs, and ornamented with a narrow brown margin around scutellum, and a narrow longitudinal sinuate spot of the same color on each elytron just behind the middle; beneath rather densely clothed with yellowish-white pubescence, and with a large triangular brown spot on the middle of each abdominal segment.

Head slightly wider than long, and nearly flat in front, feebly, broadly concave between the antennal tubercles, which are very widely separated and only slightly elevated, the surface finely, densely punctate, with a few coarse, irregularly placed punctures intermixed, a narrow longitudinal groove extending from the epistoma to occiput, and a small obtuse gibbosity on each side of the middle between the eyes; eyes large, covering half the distance between the antennal tubercles and front margin of head, separated from each other on the top by one and one-half times the width of the emargination of the eyes in front, and the two lobes connected by a narrow band without facets.

Pronotum one-third wider than long, and the apex and base about equal in width; sides nearly parallel, with a large, moderately acute tubercle at apical third; surface uneven, with three large, feebly elevated tubercles on the disk, placed two in front and one behind, and on each side a more strongly elevated tubercle, placed obliquely behind the lateral tubercle, and finely, densely punctate, with a few very coarse punctures scattered over the surface. Scutellum wider than long, and very broadly rounded behind.

Elytra three-fourths longer than wide, and distinctly wider than the pronotum; sides feebly obliquely narrowed from base to near apex, more arcuately attenuate posteriorly, and the tips broadly subtruncate; surface nearly even and regularly convex, the suture slighty elevated near apex, and each elytron broadly tumid near the base, densely and obsoletely punctate, with a few very coarse, irregularly placed punctures intermixed. Beneath finely and densely punctate, and the last abdominal segment broadly arcuately emarginate at the apex.

Female.—Differs from the male in being more robust, antennae shorter than body, and the last abdominal segment broader and slightly more subtruncate at apex.

Length, 14–18 mm.; width, 5.5–8 mm.

Type locality.—Jamaica.

Type and allotype.—Cat. No. 28381, U.S.N.M.

Described from two examples, male and female. The type (male) was labeled "Jamaica, W. I.," without any definite locality. The allotype (female) is badly rubbed, and was collected in Jamaica during October, 1923, by C. H. Ballou.

ATAXIA ALBOSCUTELLATA, new species

Female.—Elongate, parallel, castaneous; surface above rather densely clothed with recumbent yellowish-brown pubescence which partially conceals the punctures, especially on the head and pronotum; the scutellum, a small spot on the pronotum in front of scutellum, and numerous small spots on the elytra forming irregular broken longitudinal lines of whitish pubescence; there are also rather short, semierect setae arising from the punctures, the antennae sparsely clothed with short dark brown and whitish hairs intermixed, the joints narrowly annulate at base, and rather densely ciliate beneath; underside rather densely clothed with long yellowish-brown and cinereous hairs intermixed, the pubescence denser and longer on the last abdominal segment, and with numerous long, erect, whitish hairs arising from the punctures.

Head sparsely and coarsely punctate, the front wider than long, feebly convex, and rather deeply concave between the antennal tubercles. Antennae as long as the entire body; first joint elongate, reversed cone-shaped, with a distinct cicatrix at apex, and equal in length to the third joint; fourth joint distinctly longer than third, and feebly arcuate; the following joints gradually decreasing in length.

Pronotum only slightly wider than long, base and apex about equal in width; sides feebly arcuately rounded, with a rather long sharp tooth at the middle; surface nearly even, sparsely, very coarsely and irregularly punctate. Scutellum triangular, and rounded behind.

Elytra four times as long as pronotum, and distinctly wider than it at base; humeral angles broadly rounded; sides nearly parallel to apical fourth, then feebly attenuate to the tips, which are conjointly broadly arcuately emarginate, with a rather long, sharp spine at the lateral margins; surface regularly convex, obsoletely longitudinally sulcate, and sparsely, coarsely, and irregularly punctate, the punctures denser around the scutellum and more or less arranged in rows toward the sides.

Prosternum nearly flat in front, narrow between the anterior coxae, behind which it is declivous, and broadly triangularly ex-

panded. Mesosternum declivous in front, and triangular between the coxae. Metasternum with only a feeble, narrow, longitudinal groove at middle.

Abdomen beneath sparsely, obsoletely, and irregularly punctate; last segment broadly subtruncate at the tip, with a broad, concave depression at apex, the dorsal plate feebly emarginate at middle, with a broadly rounded lobe on each side. Femora nearly similar in shape, and the posterior pair extending to the anterior margin of third abdominal segment. Tibiae narrow, straight, and subcylindrical; anterior pair with a distinct sinus; and the posterior pair equal in length to the femora. Tarsi rather strongly expanded.

Length, 14 mm.; width, 4 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28382, U.S.N.M.

Described from a unique female collected at the type locality March 2, by E. A. Schwarz.

This species differs from all other known species of the genus in having the lateral spine on the pronotum acute and strongly developed, in which respect it resembles the species of *Parysatis* and *Esthlogena*, but differs from these genera in having the surface densely pubescent, and in various other characters.

Under this species I am placing temporarily two females, one received from the American Museum of Natural History, collected at Tallaboa, near Ponce, Porto Rico, July 23, 1914, the other one in the United States National Museum, collected at Mayaguez, Porto Rico, on February 27, 1912, by C. W. Hooker. These specimens differ from the type in a number of respects, but these differences do not seem sufficiently distinct to justify one in describing them as new, at least not until more material is available for study. They differ from the type in having the pubescence of a more uniform pale brownish-yellow color, with less cinereous hairs intermixed, the pronotum distinctly wider than long, with the lateral spine not quite so acute, and an obsolete nodule on each side between the lateral spine and apical angle, which indicates a relationship to the genus *Proecha;* the metasternum is more vertical in front, and in one of the specimens the tibiae are larger and more flattened.

ATAXIA UNIFORMIS, new species

Female.—Elongate, parallel, dark castaneous, moderately clothed with a uniformly colored yellowish-gray pubescence, which does not conceal the punctures, and with rather short semierect dark brown setae arising from the punctures; antennae sparsely pubescent, the joints obsoletely annulate and sparsely ciliate beneath; underside more sparsely pubescent than above, with long, slender, erect hairs arising from the punctures, and with numerous small round glabrous spots, causing the surface to have a spotted appearance.

Head finely, densely punctate, with a few very coarse, irregularly placed punctures intermixed, the front slightly wider than long, feebly convex, and nearly flat between the antennal tubercles. Antennae not quite as long as the entire body; first joint robust, oblong, truncate at apex, with a distinct cicatrix, and about equal in length to the third joint; fourth joint slightly longer than the third; the following joints nearly subequal in length.

Pronotum slightly wider than long, base and apex about equal in width: sides feebly arcuately rounded, with a small obtuse tooth at the middle: surface nearly even, rather densely, very coarsely and irregularly punctate. Scutellum triangular, and rounded behind.

Elytra four times as long as pronotum, and distinctly wider than it at base; humeral angles broadly rounded; sides nearly parallel to apical fifth, then feebly arcuately attenuate to the tips, which are conjointly broadly, but not deeply, arcuately emarginate, with a short obtuse tooth at the lateral margins; surface regularly convex, not longitudinally sulcate, but with rows of coarse, widely separated punctures.

Prosternum feebly declivous in front, narrow between the anterior coxae, behind which it is strongly declivous, and broadly triangularly expanded. Mesosternum vertical in front, triangular, and elevated between the middle coxae. Metasternum with only a feeble narrow longitudinal groove at the middle.

Abdomen beneath sparsely, obsoletely, and irregularly punctate; last segment broadly subtruncate or feebly emarginate at the tip, with a broad concave depression at the apex, and the dorsal plate feebly emarginate at middle, with a broadly rounded lobe on each side. Anterior femora slightly more robust than the middle and anterior pairs, and the posterior pair not quite extending to the third abdominal segment. Tibiae narrow, straight, and subcylindical, the anterior pair with a feeble sinus.

Male.—Differs from the female in having the last abdominal segment broadly subtruncate at apex, and without the concave depression, all of the femora more robust, tibiae broader and more flattened, the anterior pair with a distinct sinus, the posterior ones feebly arcuate, and the tarsi more broadly expanded. (Antennae missing.)

Length, 14 mm.; width, 4 mm.

Type locality.—Trinidad.

Type and allotype.—Cat. No. 28383, U.S.N.M.

Described from two more or less broken specimens, male and female, collected on the island of Trinidad during June, 1905, by August Busck.

This species can be separated from the other described West Indian species of this genus by the uniformly colored pubescence on

the dorsal surface, and by the fact that the pronotum is distinctly spinose at the sides, and the metasternum vertical in front. It is more closely related to the genus *Parysatis* than the other species found in this region.

ACREPIDOPTERUM, new genus

Mandibles large and rather thick at base. Head broad, moderately concave between the antennal tubercles, the front wider than long, and the cheeks short. Antennae about as long as the body, or at most only slightly longer than it, and moderately ciliate beneath; first joint robust, short, oblong-oval, without a cicatrix at apex, and subequal in length to the third joint, which is considerably shorter than the fourth, the following joints gradually diminishing in length. Eyes small, coarsely granulated, deeply emarginate, and the lower lobes wider than long. Pronotum nearly square, even, regularly convex, and without tubercles on sides or disk. Scutellum as wide as long, slightly triangular, and broadly rounded behind. Elytra elongate, subparallel, transversely depressed on basal half, and regularly convex posteriorly, humeri feebly developed, the surface rather even, and without lateral carinae. Legs rather long and subequal in length; femora gradually enlarged toward apex; intermediate tibiae with a distinct groove; tarsi rather short and narrow, the first joint subequal in length to the following two joints united, and the claws divergent. Mesosternum narrow between coxae, truncate posteriorly, and feebly obliquely declivous in front. Prosternal process narrow, arcuately declivous in front and behind, and triangularly expanded behind the coxae. Anterior and middle coxal cavities closed.

Genotype.—Acrepidopterum minutum, new species.

Superficially, this genus resembles *Zaplous* LeConte, but can be easily distinguished from that genus by its more elongate and depressed form, antennae more slender, and the tarsal claws divergent. It belongs to the tribe Ptericoptini and is somewhat allied to *Tethystola* Thomson, but in that genus the head is strongly concave between the antennal tubercles, front longer than wide, antennae distinctly longer than the body, and the first joint shorter than the third, eyes closer together on the top, the lower lobes quadrate, and the body more elongate and narrow.

ACREPIDOPTERUM MINUTUM, new species

Form elongate, rather narrow, and subparallel; above reddish-brown, the head, pronotum and scutellum moderately clothed with short recumbent brownish-yellow pubescence, with a few paler hairs intermixed; elytra clothed similarly to pronotum, but with numerous longitudinal streaks of whitish pubescence and a few small black

spots from each of which arises a long, stiff, black hair, and ornamented with dark brown markings as follows: On each side near the suture a narrow longitudinal somewhat sinuate spot extending from the basal gibbosity backward to basal third, a large U-shaped spot just behind the middle, which is common to both elytra, and a small oblong spot toward the sides just in front of middle. Beneath reddish-brown, with the tibiae and tarsi paler, and the surface rather sparsely clothed with short whitish pubescence.

Head nearly two times as wide as long and feebly convex in front, moderately broadly concave between the antennal tubercles, which are very widely separated and moderately elevated, the surface sparsely, coarsely, and irregularly punctate, with a narrow, obsolete, longitudinal groove on the vertex and occiput; eyes separated from each other on the top by about one and one-half times the width of the emargination of the eyes in front. Antennae yellowish-white, with the joints slightly darker at apex.

Pronotum only slightly wider than long, the apex and base equal in width, and the sides regularly arcuately rounded at middle; surface even, moderately convex, and rather densely and coarsely punctate.

Elytra slightly more than two times as long as wide, and distinctly wider than pronotum; sides nearly parallel to middle, then arcuately attenuate to the tips, which are separately narrowly rounded; surface with a broad, feebly elevated gibbosity on each elytron near the base, and densely, irregularly punctate, the punctures very coarse on basal region, but becoming much finer toward the apex.

Beneath densely and regularly punctate, the punctures on the sternum very coarse, those on the abdomen finer and more widely separated; last abdominal segment broadly rounded at apex.

Length, 3–4 mm.; width, 1–1.25 mm.

Type locality.—Cayamas, Cuba.

Type and paratypes.—Cat. No. 28384, U.S.N.M.

Described from a series of 30 specimens, all of which were collected at the type locality during December, January, and March, by E. A. Schwarz.

The species is somewhat variable in the markings on the upper surface. In some of the paratypes the pubescence is slightly more cinereous, and the anterior dark brown spot is only feebly indicated, and in one of the specimens the brown markings are nearly obliterated. After carefully examining the series, I am unable to find any good external character for separating the sexes.

ISCHNOLEA LONGIPILIS, new species

Subcylindrical, above brownish-yellow, the head and middle of pronotum more reddish-brown, with feeble indications of darker

markings on the elytra, and the antennae uniformly pale brownish-yellow; beneath chestnut-brown, except the legs and four posterior segments of abdomen, which are pale brownish-yellow; tips of mandibles black; palpi pale yellow.

Head flat between the antennal tubercles, rather densely and very coarsely punctate, rather densely clothed with recumbent yellowish-white pubescence, and with numerous long, slender, erect hairs of the same color intermixed; eyes nearly divided, not very widely separated above, and distinctly emarginate on lateral margin; antennae about four-fifths as long as body, compact, rather densely clothed with long, flying, black and yellowish-white hairs intermixed, and in addition, joints eight to eleven densely clothed with fine whitish pubescence on their exterior margin, the first joint about twice as long as wide, and the third joint slightly longer than the fourth.

Pronotum slightly wider than long, base and apex about equal in width; sides arcuately rounded, with a short obtuse tooth at the middle; anterior margin strongly arcuately rounded; surface regularly convex, densely and very coarsely punctate, rather densely clothed with short recumbent yellowish-white pubescence, forming more densely clothed, irregular lines toward the sides; and in addition, with long, flying, whitish hairs, and a large fascicle of rather densely placed, long, erect, blackish hairs at the middle.

Elytra wider than pronotum at base, two times as long as wide, broadly rounded at humeral angles, and the sides parallel to apical sixth, then arcuately attenuate to the tips, which are separately rounded; surface convex, without costae, densely, very coarsely punctate, and rather densely clothed with recumbent yellowish-white pubescence, and with more or less obsolete lines of white hairs arranged as follows: An oblong ring behind the humeri; an oblique line extending on each side from the humerus to suture at basal third, which bears a small fascicle of long white hairs, and behind the middle two transverse irregular lines, the anterior line bearing one, and the posterior line two, small fascicles of long white hairs on each side, and in addition to which are numerous long, erect, yellowish-white hairs with a few black ones intermixed.

Body beneath rather densely and finely punctate, and rather densely clothed with long recumbent yellowish-white pubescence, which conceals the punctures; last abdominal segment broadly rounded or subtruncate at apex; prosternum very narrow between the anterior coxae, not tuberculate, and the surface not raised to the level of the coxae; legs rather densely clothed with long whitish hairs.

Length, 4.4–6.1 mm.; width, 1.7–2.2 mm.

Type locality.—Cayamas, Cuba.

Type and paratype.—Cat. No. 28385, U.S.N.M.

Described from two specimens collected at the type locality on December 29 and June 8, by E. A. Schwarz.

The paratype, which was collected on December 29, differs from the type in being smaller, paler in color, the dark markings more conspicuous, and the antennae nearly as long as the body.

This species resembles *Desmiphora pallida* Bates, but can be at once separated from that genus by the fact that the prosternum is not tuberculate between the anterior coxae, the surface is not raised to the top of the coxae, and the elytra are much more coarsely and densely punctured than in *pallida*.

EUPOGONIUS ANNULICORNIS, new species

Female.—Elongate, uniformly reddish brown above, rather densely clothed with short, recumbent, yellowish-white pubescence, which does not conceal the punctures, but becomes denser in spots on the elytra, causing the surface to have a mottled appearance, and with numerous, rather long, erect setae arising from the punctures; beneath dark reddish-brown, more or less marked with rufous, with the basal half of the tibiae reddish-yellow, and the tips of the tibiae and tarsi black, the surface rather densely and irregularly clothed with recumbent yellowish-white pubescence, with a few rather long erect hairs of the same color intermixed.

Head strongly transverse and feebly convex in front, flat between the antennal tubercles, which are scarcely elevated, and the surface rather densely, coarsely, and irregularly punctate; eyes coarsely granulated, deeply emarginate, and separated from each other on the top by nearly twice the width of the emargination of the eyes in front. Antennae about as long as the body, uniformly black, except basal part of the first, third, and fourth joints, rather densely clothed with short recumbent black pubescence, except the basal half of the third and fourth joints, which are reddish-yellow, and clothed with cinereous pubescence, in addition the joints are sparsely clothed with moderately long, erect hairs; first joint robust, clavate, and scarcely one-half as long as the third joint, which is about one and one-half times as long as the fourth, the following joints much shorter and subequal in length.

Pronotum distinctly wider than long, the base and apex about equal in width; sides feebly arcuately rounded, with an obsolete obtuse tooth on each side at the middle; surface regularly convex, even, feebly transversely depressed near base, and rather densely, coarsely, and irregularly punctate.

Elytra four times as long as pronotum and considerably wider than it at base; humeral angles broadly rounded; sides feebly, obliquely expanded to apical fourth, then arcuately attenuate to the tips, which are separately broadly rounded; surface coarsely and

irregularly punctate, the punctures closely placed on the basal region, but becoming more widely separated toward the apex.

Abdomen beneath sparsely, obsoletely punctate, and feebly granulose; last segment broadly rounded at apex, and the surface broadly but not deeply depressed near the tip. Femora not very strongly swollen at middle. Tibiae slender, subcylindrical, not enlarged at the apex, and the middle ones not grooved. Tarsi narrow.

Length, 4.5 mm.; width, 1.7 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28386, U.S.N.M.

Described from a unique female collected at the type locality May 10, by E. A. Schwarz.

This species resembles *nigritarsis* Fisher somewhat in its markings, but is a much smaller species, more densely punctate, the pubescence not quite so yellow, pronotum scarcely tuberculate at the sides, and the antennae distinctly black, with the third and fourth joints conspicuously annulated with cinereous pubescence.

EUPOGONIUS NIGRITARSIS, new species

Male.—Elongate, subcylindrical, uniformly reddish-brown above, rather densely and irregularly clothed with recumbent pale yellow and cinereous hairs intermixed, and with numerous short, dark, erect hairs arising from the punctures, the small irregular pubescent and glabrous areas giving the surface a mottled appearance; beneath rufous, with the posterior margin of abdominal segments, median part of femora, tips of tibiae, and the tarsi more or less marked with fuscous, the surface densely clothed with recumbent yellowish-white pubescence, and with a few long, whitish, flying hairs intermixed, especially on the legs.

Head strongly transverse and feebly convex in front, flat between the antennal tubercles, which are feebly elevated, and the surface rather densely, deeply, and regularly punctate; eyes coarsely granulated, deeply emarginate, and separated from each other on the top by about the width of the emargination of the eyes in front. Antennae about one and one-fourth times as long as the body, reddish-brown, sparsely clothed with short recumbent brown pubescence, except the basal half of the third and fourth joints, which are paler and clothed with cinereous hairs; in addition the joints are densely clothed with rather long, flying hairs: first joint robust, clavate, about one-half as long as the third joint, which is considerably longer than the fourth, the following joints much shorter and gradually decreasing in length.

Pronotum slightly wider than long, the base and apex about equal in width; sides feebly arcuately rounded, with an obsolete obtuse tubercle on each side at the middle; surface regularly convex, even.

feebly transversely grooved near the base, with a longitudinal glabrous space at middle, and rather sparsely, coarsely, and irregularly punctate.

Elytra about three and one-half times as long as pronotum and considerably wider than it at base; humeral angles broadly rounded; sides parallel to apical fourth, then arcuately attenuate to the tips, which are separately narrowly rounded; surface regularly convex, and rather densely, coarsely, and irregularly punctate.

Abdomen beneath sparsely, obsoletely punctate, and feebly granulose; last segment broadly, but not deeply arcuately emarginate at apex. Femora strongly swollen toward apex. Tibiae rather robust, subcylindrical, not enlarged at the apex, and the middle ones not grooved. Tarsi rather narrow, at least not broadly expanded.

Length, 7 mm.; width, 2.25 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28387, U.S.N.M.

Described from a unique male collected at the type locality May 8, by E. A. Schwarz.

This species differs from *pilosulus* Chevrolat in being more reddish above, not so densely punctate, more densely pubescent, the pubescence composed of pale yellow and cinereous hairs intermixed, and the tubercles on side of pronotum obtuse. With this species I have placed a female from San Antonio de los Baños, Cuba, collected by José H. Panzos, which may be the other sex of this species. It differs from the type in being shorter, sides of elytra feebly obliquely expanded to apical third, pubescence of the same color, but without any cinereous hairs intermixed, tubercle on side of pronotum more distinct and acute, and beneath the pubescence is more brownish-yellow, and the last abdominal segment broadly depressed near apex.

EUPOGONIUS GRISEUS, new species

Male.—Elongate, subcylindrical, uniformly brownish-black above, rather densely clothed with short recumbent cinerous pubescence, which does not conceal the punctures but is arranged more or less longitudinally on the elytra, with a feeble brownish tinge along the suture, and with numerous moderately long, erect hairs arising from the punctures; beneath brownish-black, more or less marked with rufous, tarsi black, the surface densely clothed with long recumbent cinereous pubescence, and with numerous moderately long, flying hairs of the same color intermixed.

Head strongly transverse and nearly flat on the front, flat between the antennal tubercles, which are not elevated, and the surface rather densely, coarsely, and irregularly punctate; eyes coarsely granulated, deeply emarginate, and separated from each other on the top

by nearly twice the width of the emargination of the eyes in front. Antennae a little longer than the body (right antennae missing), uniformly dark brown, sparsely clothed with short, recumbent, brownish pubescence, except the basal half of the third and fourth joints, which are more rufous and clothed with cinereous pubescence, and in addition the joints sparsely clothed with moderately long, erect hairs; first joint short, robust, subclavate, and scarcely one-half as long as the third, which is a little longer than the fourth, the following joints much shorter, and gradually decreasing in length.

Pronotum distinctly wider than long, apex and base about equal in width; sides feebly arcuately rounded, with an obtuse tooth on each side at the middle; surface regularly convex, even, and rather densely, coarsely, and irregularly punctate.

Elytra four times as long as pronotum and considerably wider than it at base; humeral angles broadly rounded; sides parallel to apical fourth, then arcuately attenuate to the tips, which are separately, rather narrowly rounded; surface rather densely, very coarsely, and irregularly punctate.

Abdomen beneath sparsely, obsoletely punctate, and obsoletely granulose; last segment broadly rounded at apex. Femora strongly swollen toward apex. Tibiae rather robust, subcylindrical, feebly enlarged at apex, and the middle ones not grooved. Tarsi rather narrow.

Length, 5–6 mm.; width, 1.75–2 mm.

Type locality.—Cayamas, Cuba.

Type and paratype.—Cat. No. 28388, U.S.N.M.

Described from two males collected at the type locality on May 24 and June 10, by E. A. Schwarz.

This species can be separated from all the other described species of this genus found in the West Indies by the distinct cinereous pubescence above, which is arranged more or less longitudinally on the elytra.

ESTOLA ATTENUATA, new species

Elongate, robust, subcylindrical, and more or less cuneiform; above reddish-brown to brownish-black, densely clothed with short recumbent ocherous pubescence, obsoletely variegated with small, irregularly placed areas of paler yellow pubescence, and with numerous short erect hairs which are slightly pointed backward; at the base of these erect hairs the pubescence is obsoletely cinereous; beneath, the pubescence is more cinereous than above, and the abdomen and legs strongly variegated with yellowish-brown pubescence, causing the surface to have a mottled appearance, and with numerous longer erect hairs intermixed; mandibles brownish-black; palpi reddish-brown, with the tips paler.

Head strongly transverse and flat in front, feebly concave between the antennal tubercles, which are feebly elevated and widely separated, the surface sparsely, coarsely, and irregularly punctate, with a narrow longitudinal groove extending from the epistoma to the occiput; eyes rather coarsely granulated, very deeply emarginate, and separated from each other on the top by a little more than the width of the emargination of the eyes in front, the lower lobes slightly longer than wide, and the upper lobes very small and narrow. Antennae rather robust, about as long as the body, yellowish-white, with the tips of the joints irregularly annulated with brown, the surface sparsely clothed with short cinereous pubescence, except the first joint, which is more densely clothed with longer cinereous and ocherous pubescence intermixed, and all the joints sparsely ciliate beneath; first joint short, reversed cone shaped, not extending to middle of pronotum, and slightly shorter than the third joint, which is subequal in length to the fourth, the following joints shorter and gradually decreasing in length.

Pronotum distinctly wider than long, apex and base about equal in width; sides feebly arcuately rounded, with a short, rather acute tooth on each side at middle; surface somewhat uneven, and rather densely, coarsely punctate. Scutellum semicircular, smooth, and densely pubescent.

Elytra at base nearly a third wider than the pronotum, and two times as long as wide; humeral angles broadly rounded; sides gradually arcuately attenuate from base to the tips, which are separately narrowly rounded; surface regularly convex, obsoletely costate near suture, with rows of coarse, irregularly placed punctures, and the intervals densely, obsoletely punctate.

Prosternum arcuately declivous in front and behind, and narrow between the anterior coxae. Mesosternum vertical in front and triangular between the middle coxae. Abdomen beneath densely, obsoletely punctate, with a few coarser punctures toward the sides; last segment feebly concave near apex, which is truncate and slightly emarginate. Femora moderately robust, the anterior pair slightly more swollen than the middle and posterior ones, the latter extending to the posterior margin of the third abdominal segment. Tibiae rather slender, straight, and subcylindrical. Tarsi narrow and not broadly expanded.

Length, 9.5–10.5 mm.; width, 4–4.25 mm.

Type locality.—Jamaica.

Type and paratype.—Cat. No. 28389, U.S.N.M.

Described from two specimens, probably both females. The type was collected by W. Schaus and the paratype by C. H. Ballou during October, 1923. The paratype is slightly smaller than the type and the elytra is not quite so strongly acuminate posteriorly.

This species resembles *Estola ignobilis* Bates very closely, but is more cuneiform, the pubescence denser and more ocherous, and the head has a distinct longitudinal groove on the front.

JAMESIA LINEATA, new species

Robust and oblong-triangular, uniformly piceous above and beneath, and clothed with ocherous pubescence; mandibles black; palpi black, with the tips reddish.

Head very elongate, narrowly triangular and flat in front, deeply angularly depressed between the antennal tubercles, which are rather strongly elevated and nearly contiguous, the surface coarsely rugose, with a few short ocherous hairs between the rugae; eyes feebly convex, deeply emarginate, and narrowly separated from each other on the top, the lower lobes nearly quadrate, and the upper lobes very small and narrow. Antennae rather robust, longer than body (last three joints missing), reddish-black, densely clothed with very short, recumbent brownish pubescence, and densely ciliate on the under side of the joints with long erect hairs; first joint rather long, subcylindrical, and extending to middle of pronotum; third joint slightly longer than the first and fourth, and the fifth to eighth joints subequal in length.

Pronotum nearly two times as wide as long, and the apex and base nearly equal in width; sides nearly parallel and unarmed; surface uneven, coarsely rugose, sparsely clothed with short recumbent brownish-yellow pubescence, and the anterior and posterior margins with a fringe of densely placed, long, recumbent orange-yellow hairs. Scutellum large, triangular, broadly truncate behind, and rather densely pubescent.

Elytra at base nearly a half wider than pronotum, and two times as long as wide; humeri strongly developed, and produced into a short obtuse tubercle; sides feebly obliquely narrowed from base to near apex, then strongly arcuately attenuate to the tips, which are conjointly broadly rounded; surface regularly convex, with a few small, irregularly placed tubercles near base, densely clothed with short, recumbent, ocherous pubescence, and each elytron with the suture, anterior margin, and three narrow longitudinal lines glabrous, the second and third lines connected to each other near the apex, and the first connected to the second at the apical fifth, these lines ornamented with a number of coarse, irregularly placed punctures, in which is a small spot of whitish pubescence.

Prosternum arcuately declivous in front and behind, triangular between the anterior coxae, with the lateral margins strongly elevated. Mesosternum broad, feebly declivous in front, and deeply, angularly emarginate behind. Abdomen beneath nearly smooth, and densely clothed with short, recumbent, ocherous pubescence;

last segment broadly subtruncate at apex. Femora only feebly swollen, and the posterior pair extending to near the posterior margin of the third abdominal segment. Tibiae straight, subcylindrical, and gradually enlarged toward the apex. Tarsi with the first joint gibbous on the dorsal surface.

Length, 32 mm.; width, 12.5 mm.

Type locality.—Santa Lucia Island, West Indies.

Type.—Cat. No. 28390, U.S.N.M.

Described from a single example collected by H. A. Ballou. This beautiful species can at once be distinguished from all the other described species of the genus by the elytra having distinct longitudinal glabrous lines, which are ornamented with small whitish pubescent spots.

LEPTOSTYLUS LONGICORNIS, new species

Form elongate, not very robust, feebly convex above, uniformly reddish-brown, densely clothed with cinereous pubescence, with a few darker spots on elytra behind middle, and numerous small ocherous areas; mandibles black; palpi uniformly reddish-brown.

Head nearly flat and quadrate in front of the antennal tubercles, deeply angularly depressed between the antennal tubercles, which are strongly developed and nearly contiguous at their base, the surface densely clothed with short, recumbent, cinereous, and yellowish pubescence, concealing the surface, and with a narrow, longitudinal groove extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by about two-thirds the width of the emargination of the eyes in front, the lower lobes rounded and the upper lobes small and narrow.

Antennae more than two times as long as the body (eleventh joint missing), first four joints obsoletely mottled brown and cinereous, the following joints cinereous, with the apex of the joints more or less brownish; first joint rather slender, subclavate, slightly produced on under side at apex, extending to basal fourth of the pronotum, and subequal in length to the fourth joint, which is slightly shorter than the third.

Pronotum one-half wider than long, and the base and apex about equal in width; sides strongly constricted near apical angles, strongly and broadly tumid at middle, and parallel at basal fourth; surface with a broad transverse basal and apical constriction, with seven tubercles arranged in two transverse rows on the disk, of which the three median ones are more strongly elevated, with a few widely scattered coarse punctures and a more distinct series in the apical and basal constrictions; the surface also densely clothed with recumbent, yellowish-white pubescence, and ornamented with a broad

median brown vitta extending from the anterior margin to the base. Scutellum triangular, very broadly rounded behind, and the surface flat and very sparsely pubescent.

Elytra two-thirds longer than wide, and one-fourth wider than the pronotum; humeri rather strongly developed and feebly elevated; sides arcuately rounded, more strongly apically, to the tips, which are strongly obliquely truncate internally, with the inner margin feebly, arcuately emarginate, and the exterior angles rather acute and moderately produced; surface uneven, with an oblique impression extending from near the humeri to the suture, rather densely, finely, and irregularly punctate over entire surface, densely clothed with cinereous pubescence, which has a slight brownish tinge in some parts, with numerous irregularly placed tubercles, which are densely clothed with ocherous pubescence, and each elytron with a transverse sinuate brownish-black spot along suture near the middle, a similar but smaller spot behind it situated on middle of disk, and two more or less obsolete elongate spots of the same color near apical fourth, and the apical part more variegated with ocherous pubescence than the basal half.

Beneath finely, densely punctate, with a few coarser punctures intermixed, and sparsely, irregularly clothed with cinereous and brownish-white pubescence, giving the surface a mottled appearance; tibiae at apex, last two tarsal joints, and the tarsal claws brown; prosternal process about two-thirds as wide as the coxal cavity; femora strongly clavate.

Length, 11.5 mm.; width, 4.50 mm.

Type locality.—"Porto Rico Exp. Sta." (Rio Piedras, Porto Rico.)

Type.—Cat. No. 28391, U.S.N.M.

Described from a single male, labeled simply "Porto Rico Exp. Sta." There is also a very small specimen received from the American Museum of Natural History, collected at Aibonito, Porto Rico, between July 14 and 17, 1914, which I have placed under this species. This specimen is only 6 mm. long, but is nearly identical in all other respects with the type. It probably represents a specimen which has developed prematurely on account of insufficient food.

This species can be separated from the other known West Indian species of the genus by its extremely long antennae.

LEPTOSTYLUS ALBOFASCIATUS, new species

Form shorter and more convex than *poeyi* Fisher, reddish black, rather densely clothed with pale brown and brownish-black pubescence, with a narrow W-shaped mark of cinereous pubescence along the suture at the middle, common to both elytra, with the base pointed backward; mandibles black, with the base reddish; palpi yellowish brown.

Head quadrate in front of antennal tubercles, slightly narrower above, and nearly flat, moderately angularly depressed between the antennal tubercles, which are moderately developed and rather widely separated, the surface not very densely clothed with short, recumbent, whitish and brownish pubescence, which does not quite conceal it, and with an obsolete narrow longitudinal groove extending from the epistoma to occiput; eyes rather large, not very coarsely granulated, deeply emarginate, and separated from each other on the top by about three-fourths the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes narrow. Antennae slightly longer than the body, the joints to the fifth mottled dark brown and white, those beyond cinereous, and all the joints annulated with dark brown at the apex and base; first joint rather slender, subcylindrical, gradually expanded toward apex, extending to about middle of pronotum, and subequal in length to the third joint, which is only slightly longer than the fourth.

Pronotum nearly two times as wide as long, and the apex and base about equal in width; sides feebly obliquely expanded from anterior angles to middle where they are obtusely tumid, and then parallel at basal fourth; surface with a feebly transverse apical and basal constriction, and seven feebly elevated tubercles on the disk, four anteriorly and three posteriorly, arranged in two transverse lines, with a few widely scattered coarse punctures and a more distinct row in the apical and basal constrictions, the surface rather densely clothed with recumbent yellowish-white pubescence, and ornamented with darker areas as follows: A large longitudinal spot posteriorly along the lateral margin, and three more or less interrupted longitudinal vittae on the disk, one median and one on each side, and more or less connected to each other along the anterior margin. Scutellum triangular, rather acutely rounded behind, and the surface nearly flat and rather densely pubescent.

Elytra three-fourths longer than wide, and one-fourth wider than pronotum; humeri rather prominent and feebly elevated; sides arcuately rounding, more so apically, to the tips, which are feebly obliquely truncate internally, with the exterior angles obtuse, but not produced; surface strongly convex, even, finely, irregularly, but not very densely punctate over entire area, rather densely clothed with irregular patches of pale brown and brownish-black pubescence, with a few small tubercles clothed with dark brown pubescence, and ornamented with a number of small, irregularly placed spots of cinereous pubescence, which form a more or less distinct W at the middle common to both elytra.

Beneath densely, obsoletely punctate, and sparsely clothed with cinereous and brownish pubescence, which gives the surface a mottled

appearance; tibiae strongly annulated with brown at middle and apex, and the tarsi and tarsal claws more or less brownish; prosternal process three-fourths as wide as the coxal cavity; femora moderately clavate.

Length, 7 mm.; width, 3.2 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28392, U.S.N.M.

Described from a unique male collected at the type locality on June 8, by E. A. Schwarz.

This small convex species is easily known by its W-shaped, cinereous fascia near the middle of the elytra.

LEPTOSTYLUS ATROMACULATUS, new species

Form similar to *poeyi* Fisher, but more robust and convex above, brownish-black, densely clothed with cinereous or brownish-white pubescence, and ornamented with numerous black spots; mandibles black, with the base reddish; palpi brown, with the tips slightly paler.

Head quadrate in front of antennal tubercles, and nearly flat, moderately concave between the antennal tubercles, which are moderately developed, and rather widely separated, the surface densely clothed with short recumbent cinereous pubescence, more or less mottled, concealing the surface, and with a moderately distinct narrow longitudinal groove extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by about the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes very narrow. Antennae slightly longer than the body, mottled with brown and cinereous pubescence and the outer joints more or less annulated with brown; first joint slender, subcylindrical, feebly expanded toward the apex, extending to basal fourth of pronotum, and subequal in length to the third joint, which is distinctly longer that the fourth.

Pronotum three-fifths wider than long, and the apex and base about equal in width; sides feebly obtusely tumid at middle; surface with a feeble transverse apical and basal depression, and with seven tubercles on the disk arranged in two transverse lines, the five median ones more strongly elevated, with numerous widely scattered coarse punctures and a more distinct row in the apical and basal depressions, the surface also rather densely and irregularly clothed with recumbent whitish pubescence, and ornamented with darker areas as follows: Three small spots along anterior margin, of which the exterior ones are more elongate, and a large spot on the three median tubercles, placed two in front and one behind, the latter with the dark spot extending to the base. Scutellum broadly triangular,

subtruncate behind, the surface feebly concave, densely clothed with dark brown and cinereous pubescence, except for a median longitudinal glabrous line.

Elytra four-fifths longer than wide, and a fifth wider than the pronotum; humeri not very prominent or elevated; sides nearly parallel to apical third, then strongly arcuately attenuate to the tips, which are feebly obliquely truncate internally, with the exterior angles obtuse, but not produced; surface regularly convex, rather even, finely, densely, and irregularly punctate over entire surface, densely clothed with recumbent cinereous pubescence, which is slightly browner toward the sides and nearly conceals the punctuation, with numerous irregularly placed tubercles, which are densely clothed with black pubescence, and each elytron with two or three black spots placed transversely at apical third, behind which the surface is variegated with cinereous, ocherous, and brownish pubescence, with a few small black spots intermixed.

Beneath finely, densely punctate, and rather densely clothed with cinereous pubescence, which is more or less mottled; tibiae feebly annulated with brown at middle and apex; last two tarsal joints and claws brownish-black; prosternal process nearly as wide as the coxal cavity; femora strongly clavate.

Length, 9 mm.; width, 4.3 mm.

Type locality.—Central Constancia, Cuba.

Type.—Cat. No. 28393, U.S.N.M.

Described from a single example, probably a male, collected at the type locality by J. F. Merrill, during May, 1914.

This species is separated from the other known species of this genus found in the West Indies by its regularly convex and rather even elytra, which are clothed with cinereous pubescence, with a more or less interrupted black fascia at apical third, and ornamented with numerous small black tubercles.

LEPTOSTYLUS DUVALI, new species

Form strongly robust and moderately convex above, uniformly reddish-brown, not very densely clothed with yellowish-white pubescence, and ornamented with darker and paler areas; mandibles black, with base reddish; palpi orange yellow.

Head quadrate in front of antennal tubercles, and nearly flat, rather deeply, angularly depressed between the antennal tubercles, which are moderately developed, and rather widely separated, the surface not very densely clothed with short recumbent yellowish-white pubescence, more or less mottled, not quite concealing the surface, and with a moderately distinct narrow longitudinal groove extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on

the top by about two-thirds the width of the emargination of the eyes in front, the lower lobes rounded and the upper lobes narrow. Antennae about one and one-fourth times as long as the body, the first four joints maculate with brownish and cinereous pubescence, the following joints cinereous, and all the joints narrowly annulated with dark brown at the base and apex; first joint slender, subcylindrical, gradually expanded toward apex, extending to basal fourth of pronotum, and subequal in length to the third joint, which is nearly a half longer than the fourth.

Pronotum one-half wider than long, and the apex only slightly wider than base; sides feebly rounded, only slightly more so, and broadly arcuate medially, without any distinct prominence or tubercle; surface only feebly constricted along base and apex, the disk nearly even, with only a slight evidence of tubercles, coarsely and rather densely punctate, with a more distinct transverse row along the base and apex, and irregularly, but not very densely clothed with recumbent yellowish-white pubescence, without any distinct darker markings. Scutellum slightly triangular, much wider than long, very broadly rounded or subtruncate at apex, and the surface feebly concave and sparsely pubescent.

Elytra three-fourths longer than wide and one-third wider than the pronotum; humeri not prominent or elevated; sides nearly parallel to apical third, then strongly, arcuately attenuate to the tips, which are obliquely truncate internally, with an obtuse but evident external angle; surface regularly convex, deeply and irregularly punctate, the punctures coarse and densely placed on basal region, and becoming finer and sparser toward the apex, rather sparsely clothed with recumbent yellowish-white pubescence, with irregular rows of small tubercles, which are densely clothed with longer yellowish-white pubescence on the basal region, and intermixed with dark brown pubescence toward the apex; each elytron ornamented with two small irregularly shaped, dark brown spots at apical fifth, of which the exterior spot is placed along the lateral margin slightly behind the interior one.

Beneath finely, densely punctate, and sparsely, irregularly clothed with yellowish-white pubescence, which gives the surface a more or less mottled appearance; tibiae annulated with brown at middle and apex, and the tarsi and tarsal claws more or less brown; prosternal process about three-fourths as wide as the coxal cavity; femora strongly clavate.

Length, 11 mm.; width, 5 mm.

Type locality.—Cuba.

Type.—Cat. No. 28394, U.S.N.M.

Described from a single example, probably a female, and labeled simply "Cuba," without additional data.

This species is of a nearly uniform color above, with only a few dark spots at the apical fifth of elytra and is sparsely pubescent. It resembles *jamaicensis* Gahan, but that species has a more or less distinct oblique fascia near the middle of the elytra, in front of which the surface is more cinereous.

LEPTOSTYLUS SCURRA, var. DORSALIS, new variety

Above rather densely clothed with short recumbent yellowish-white pubescence, the pronotum with the median part of disk slightly more brownish, and with two small black spots on the median line, one at the anterior margin, the other at basal third; elytra with a large brownish-black spot covering the scutellum and entire anterior surface, except for a large triangular pale area at the humeri, the posterior margin of the spot extending from near the lateral margin at apical fourth obliquely forward to the suture at apical third, and the anterior margin extending from near the lateral margin at basal fourth obliquely forward to the scutellum. There are also a few very small, irregularly placed black spots on the pale apical area; antennae mottled dark brown and yellowish-white; beneath luteous, and the legs more or less mottled with brown and black; last abdominal segment at apex feebly arcuately emarginate in the female and subtruncate or very broadly rounded in the male.

Length, 3.75–4.75 mm.; width, 1.5–2 mm.

Type locality.—Cayamas, Cuba.

Other localities.—Paradise Key and Miami, Florida.

Type, allotype, and paratypes.—Cat. No. 28395, U.S.N.M.

Paratypes.—Collection J. N. Knull.

Described from seven specimens, two females and five males. The type (female) collected May 29, and the allotype January 29, at the type locality, by E. A. Schwarz; one male collected March 12, 1919, at Paradise Key, Florida, by the same collector; one male collected from "*Anona cherimola*" at Miami, Florida, during March, 1918, by H. L. Sanford; a male and female collected at Paradise Key, Florida, March 10, 1921, and one male from Miami, Florida, collected March 21, 1921; the last three specimens collected by J. N. Knull.

This variety differs from the typical *scurra* chiefly in having the elytra entirely brownish-black, with the exception of the lateral margin, apical region, and a large triangular area at humeri, where the color is yellowish-white.

LEPTOSTYLUS SCURRA, var. MACULIFER, new variety

Female.—Above rather densely clothed with short recumbent yellowish-white pubescence, the pronotum with the median part of disk slightly more brownish, and with two small black spots on the median line, one at the anterior margin and the other at the base; elytra

with a narrow black margin around the scutellum, a few scattered black elevated spots over the surface, an elongate black spot along lateral margin, extending from the anterior angles to middle and a distinct small, diamond-shaped, black spot common to both elytra, placed just behind the middle, beneath luteous, with the legs more or less mottled with dark brown; antennae pale, mottled with brown, and the joints annulated with the same color at apex; last abdominal segment subtruncate at apex.

Male.—Differs from the type in having the antennae slightly longer, the surface above and beneath of a darker brown color, with more or less whitish pubescence on the elytra, especially around the diamond-shaped black mark.

Length, 4–4.75 mm.; width, 1.6–2 mm.

Type locality.—Estacion Experimental Agronomica, Santiago de las Vegas, Cuba (female type); Cayamas, Cuba (male allotype).

Type and allotype.—Cat. No. 28396, U.S.N.M.

Described from two examples, the type labeled simply "Est. Cent. Agr. de Cuba, # 8073," and the allotype collected at Cayamas, June 6, by E. A. Schwarz.

This variety can be easily separated from the typical *scurra* by the distinct diamond-shaped black spot on the elytra.

LEPTOSTYLUS BIUSTUS, var. CUBANUS, new variety

Above rather densely clothed with short, recumbent, cinereous, and ocherous pubescence, the pronotum with a longitudinal median line and a small spot on each side near anterior margin dark brown; scutellum brown; elytra with a longitudinal sinuate black spot on each side near the lateral margin extending from the humeral angle to the middle, with a number of small elevated black spots scattered over the surface, and on each elytron at apical fourth an arcuate black spot, which is sometimes divided into two distinct spots, and just behind the middle a rather broad olivaceous-brown fascia extending obliquely backward toward the lateral margin, connected internally to a broad vitta of the same color extending along the suture and strongly expanded anteriorly, but not reaching the base or lateral margin; antennae pale, mottled with light brown, and the outer joints strongly annulated with dark brown; beneath reddish-brown, the abdomen paler, legs more or less mottled, and tarsi brownish-black; last abdominal segment subtruncate or feebly emarginate at apex.

Length, 5–5.5 mm.; width, 2–2.25 mm.

Type locality.—Cayamas, Cuba.

Type and paratype.—Cat. No. 28397, U.S.N.M.

Described from two females collected at the type locality on March 2, and May 8, by E. A. Schwarz.

This variety can be separated from the typical *biustus* by the broad, olivaceous-brown markings on disk of elytra, which are only indicated in the typical form by a narrow oblique fascia on each elytron just behind the middle, and form an inverted letter V common to both elytra.

LEPTOSTYLUS BRUNERI, new species

Form rather short and robust, strongly convex, dark brown, densely clothed with cinereous and brownish-white pubescence, and ornamented with brownish-black pubescent markings; mandibles black; palpi brownish-black, with the tips luteous.

Head between the eyes in front of antennal tubercles about as long as wide, and feebly convex, broadly concave between the antennal tubercles, which are moderately developed, and rather widely separated, the surface densely, somewhat irregularly clothed with recumbent yellowish-white pubescence, giving it a feebly mottled appearance, and concealing the punctuation, and with a narrow longitudinal groove extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by nearly the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes very narrow. Antennae about one and one-fourth times as long as the body, the first four joints mottled with brown and cinereous pubescence, the following joints (except the last, which is entirely brown) more or less annulated with brown; first joint slender, subcylindrical, feebly expanded toward apex, extending to basal third of pronotum, and subequal in length to the third joint, which is slightly longer than the fourth.

Pronotum three-fifths wider than long, base and apex about equal in width; sides feebly constricted near apical angles, broadly arcuately rounded at middle, and parallel at basal fifth; surface with a feeble transverse apical and basal depression, and with three distinct but not very strongly elevated tubercles on the disk, two in front and one behind, with a distinct row of rather coarse punctures in the apical and basal depressions, the surface also densely clothed with recumbent whitish pubescence, and ornamented with brownish-black areas as follows: Two small obsolete spots along anterior margin, a large spot on each side along lateral margin extending from the middle to base, three small spots along base, and the three discal tubercles covered with pubescence of the same color. Scutellum broadly triangular, broadly rounded behind, the surface nearly flat, and sparsely clothed with cinereous pubescence.

Elytra four-fifths longer than wide, and a fifth wider than the pronotum; humeri rather prominent but not strongly elevated; sides nearly parallel to middle, then arcuately attenuate to the tips,

which are feebly obliquely truncate internally, with the exterior angles obtuse, but not produced; surface regularly convex, rather even, and each elytron with an oblique longitudinal costa on disk extending from behind the humerus to apical third, rather densely and irregularly punctate, the punctures coarser on basal region but becoming more obsolete toward the apex, densely clothed with recumbent brownish-white pubescence, which is browner toward the sides behind the humeri, broadly cinerous along the base, the brownish-black markings narrowly bordered anteriorly with cinereous pubescence, with a few small, irregularly placed black spots in basal region, along suture and anterior margins, and on the discal costae, and each elytron ornamented with brownish-black markings as follows: Two small spots along the lateral margin, one at humeral angle, the other behind the humerus, and a bisinuate oblique fascia behind the middle, posterior to which are two irregularly shaped spots, which are more or less connected to the fascia anteriorly.

Beneath finely, densely punctate, and rather sparsely clothed with cinereous pubescence; last abdominal segment strongly narrowed at apex and produced slightly behind the elytra; tibiae more or less annulated with brown; tarsi and tarsal claws brownish-black; prosternal process as wide as coxal cavity; femora strongly clavate at apex.

Length, 9.5 mm.; width, 4.2 mm.

Type locality.—Nagua, Oriente, Cuba.

Type.—Cat. No. 28398, U.S.N.M.

Described from a unique female collected at the type locality July 7, 1922, by S. C. Bruner and C. H. Ballou.

In this species the female has a very short extended ovipositor as in *Atrypaninus*, but can be easily distinguished from the species in that genus by the lower lobes of the eyes being rounded and not longer than wide. It is not entirely congeneric with *Leptostylus*, on account of the short extended ovipositor, but seems to be intermediate between *Atrypanius* and *Leptostylus;* however, it seems advisable to retain it in the latter genus, at least for the present, until more material is available for study.

LEPTOSTYLUS PYGMAEUS, new species

Form very small, short, robust, and strongly convex, dark brown, rather densely clothed with yellowish pubescence, and ornamented with dark brown and cinereous pubescent markings; mandibles brownish-black; palpi yellowish-brown.

Head about as long as wide, nearly flat, and slightly narrowed above in front, broadly and rather deeply concave between the antennal tubercles, which are moderately developed and rather widely separated, the surface subopaque, densely, finely granulose,

sparsely clothed with inconspicuous recumbent pubescence, and with a rather broad longitudinal groove extending from the epistoma to occiput; eyes small, not very coarsely granulated, deeply emarginate, and separated from each other on the top by nearly two times the width of the emargination of the eyes in front, the lower lobes subrounded, slightly more acute beneath, and the upper lobes small and narrow. Antennae slightly longer than the body, luteous or reddish-yellow, and the joints more or less annulate with brown at apex; first joint slender, subcylindrical, extending slightly beyond middle of pronotum, and subequal in length to the third joint, which is considerably longer than the fourth.

Pronotum two-thirds wider than long, and the base and apex about equal in width; sides strongly constricted near anterior and posterior angles, and strongly arcuately rounded at middle; surface slightly convex, with a narrow transverse apical and basal depression, coarsely, densely punctate, the intervals granulose, and rather densely clothed with recumbent pubescence, which is whitish and yellowish toward the sides and brownish on the median parts. Scutellum triangular, and rather narrowly rounded behind.

Elytra nearly three-fifths longer than wide, and a fifth wider than the pronotum; humeri feebly developed; sides nearly parallel to apical third, then arcuately attenuate to the tips, which are feebly obliquely truncate internally, with the exterior angle obtuse, but not produced; surface regularly convex, without costae, but with a broad oblique depression behind the humeri, densely, coarsely punctate, the intervals granulose, and rather densely clothed with recumbent yellowish pubescence, with a small white spot behind the scutellum, more or less whitish in the oblique depression, with a distinct transverse sinuate fascia at middle, which is transverse laterally and bent obliquely forward to the suture, and each elytron ornamented with brown markings as follows: A rather large spot behind the scutellum, a large more or less interrupted triangular spot along lateral margin at middle, a narrow longitudinal crescent-shaped spot on disk behind the middle, and connected posteriorly to a narrow transverse fascia extending to the lateral margin, and with a row of small round spots along the suture.

Beneath rather finely, densely punctate, and sparsely clothed with moderately long cinereous pubescence; last abdominal segment broadly rounded at apex and not produced beyond the elytra; femora strongly clavate toward apex; tibiae more or less annulated, and the tarsi and tarsal claws dark brown; prosternal process about one-half as wide as the coxal cavities.

Length, 2.75 mm.; width, 1.2 mm.

Type locality.—Cayamas, Cuba.

Type and paratypes.—Cat. No. 28399, U.S.N.M.

Described from seven examples, probably all females except one; all collected at the type locality during February and May, by E. A. Schwarz.

This is the smallest known species of this genus and on account of the rounded sides of the pronotum should probably be taken as the type of a new genus, but until a revision is made of the entire tribe, it is advisable to retain it in the present genus.

LEIOPUS CUBANUS, new species

Male.—Form less elongate and more oval than *atrovittatus* Fisher; above reddish-brown, rather densely clothed with cinereous and brownish-yellow pubescence, and ornamented with more or less distinct, irregularly placed black markings; beneath reddish-brown, with the abdomen more yellowish, and the basal part of the femora, apex of tibiae, and tarsi black.

Head slightly transverse and nearly flat in front, slightly concave between the antennal tubercles, which are feebly elevated and widely separated, the surface densely clothed with cinereous and brownish-yellow pubescence, giving it a mottled appearance and concealing the punctuation, and with an obsolete, longitudinal groove extending from the epistoma to occiput; eyes rather coarsely granulated, deeply emarginate, and separated from each other on the top by about the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes small and narrow. Antennae one and three-fourths times as long as the body, pale rufous or luteous, mottled with cinereous and brownish pubescence, the joints more or less annulated dark brown or black, except the last joint, which is of a uniform black or dark-brown color.

Pronotum three-fourths wider than long, and slightly narrower at base than apex; sides feebly arcuately rounded from apical angles to an acute, prominent denticle near the base, behind which they are strongly and abruptly constricted; surface even, with an obsolete narrow transverse depression along the anterior margin, and a broader depression along the base, sparsely, rather coarsely and irregularly punctate, densely clothed with cinereous and brownish-yellow pubescence, which is usually browner on the median parts, and ornamented with three or four small black discal spots.

Elytra three-fourths longer than wide, and distinctly wider than the pronotum; sides parallel to apical third, then arcuately attenuate to the tips, which are feebly obliquely truncate internally, with the exterior angles obtusely rounded; surface uneven, strongly declivous at the sides, but the carina not distinctly marked, the discal lines obsolete, densely and irregularly punctate, the punctures in the basal region rather coarse, but becoming finer toward the apex, with numerous, irregularly placed black fasciculi, rather

densely clothed with cinereous and brownish-yellow pubescence, which is more cinereous in the scutellar and apical regions, and each elytron with a few irregularly shaped, blackish markings at the middle, and a more or less distinct, narrow, transverse, cinereous fascia just behind the middle which is bent forward into a small acute angle at middle of disk.

Beneath densely, obsoletely punctate, and sparsely clothed with cinereous pubescence; last abdominal segment slightly longer than the fourth and subtruncate at apex; middle coxae separated by about their own width; femora strongly clavate toward apex, and the anterior pair distinctly shorter than the middle and posterior pairs; basal joint of hind tarsi shorter than the following joints united.

Female.—Differs from the male in having the antennae shorter (last joint missing), femora not quite so strongly clavate, and the last abdominal segment longer, more acuminate, and feebly arcuately emarginate at apex.

Length, 4.5–5 mm.; width, 2–2.4 mm.

Type locality.—Cayamas, Cuba.

Type, allotype, and paratypes.—Cat. No. 28400, U.S.N.M.

Described from four specimens, three males and one female, collected at the type locality by E. A. Schwarz, between May 6 and June 5.

The specimens examined vary a good deal in the coloration above. In some examples the black markings on the pronotum are very distinct, the median one extending from the middle to the base, and there is also a more or less distinct black mark at the lateral tubercles, but in one specimen these black markings are only vaguely indicated. The pubescence on the elytra is also more brownish-yellow, and the transverse cinereous fascia nearly obsolete.

LEPTURGES CHAMAEROPSIS, new species

Male.—Form narrow, elongate, and rather strongly depressed above, similar to *signatus* LeConte, luteous in color, with the sides and apex of elytra slightly more luteo-testaceous, and without any maculations.

Head nearly square and strongly convex in front, feebly depressed between the antennal tubercles, which are scarcely elevated, and widely separated, the surface densely and very finely granulose, sparsely clothed with inconspicuous recumbent cinereous pubescence, and with a distinct narrow longitudinal groove extending from the epistoma to occiput; eyes rather small, not very coarsely granulate, deeply emarginate, and separated from each other on the top by about the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes small and narrow. Antennae two times as long as the body, uniformly dark luteous, and sparsely clothed with inconspicuous cinereous pubescence.

Pronotum two-sevenths wider than long, the apex and base about equal in width, and feebly trapezoidal; sides feebly obliquely expanded from apical angles to basal fifth, then strongly, abruptly constricted to base, the tooth strongly developed, acute at apex, and extending slightly outward; surface even, with a feeble, broadly concave depression along base, densely and very finely punctate, with a row of coarse punctures along the base, and sparsely clothed with fine, recumbent, cinereous pubescence. Scutellum wider than long, and broadly rounded behind.

Elytra fully two times as long as wide, and distinctly wider than pronotum; sides parallel to apical third, then arcuately attenuate to the tips, which are separately narrowly rounded; surface convex along the sides, flattened on disk, coarsely, densely, and regularly punctate over entire surface, and sparsely clothed with fine recumbent cinereous pubescence.

Beneath finely and densely punctate, and rather densely clothed with short recumbent cinereous pubescence; last abdominal segment moderately cuneate, and broadly, but feebly arcuately emarginate at apex; anterior and middle coxae separated by about one-fourth of their diameter; anterior and middle femora rather strongly clavate, the posterior pair linear and only feebly clavate; tarsi rather short, the basal joint of the posterior pair about as long as the following two joints united.

Female.—Differs from the male in having the pronotum nearly two times as wide as long, the femora less strongly clavate, and the last abdominal segment longer and more acuminate at apex.

Length, 6–6.75 mm.; width, 2–2.25 mm.

Type locality.—Cayamas, Cuba.

Type, allotype, and paratypes.—Cat. No. 28401, U.S.N.M.

Described from five specimens, two males and three females collected at the type locality between February 5 and March 10, by E. A. Schwarz.

In general form this species resembles *Lepturges signatus* LeConte, but it is of a nearly uniform color and is without any distinct markings on the pronotum or elytra.

HYPERPLATYS GRISEOMACULATUS, new species

Male.—Form oblong, rather robust, and moderately depressed; above brown with a slight reddish tinge, and irregularly mottled with whitish pubescence; beneath pale brownish-red, the abdomen slightly more yellowish, and the legs dark brown, with the femora, tibiae, and basal part of first tarsal joints luteous.

Head nearly square, slightly narrowed above, and nearly flat in front, feebly depressed between the antennal tubercles, which are only slightly elevated and widely separated, the surface rather

densely, obsoletely punctate, moderately clothed with recumbent whitish pubescence, and with a very distinct longitudinal groove extending from the epistoma to occiput; eyes large, rather coarsely granulate, deeply emarginate, and separated from each other on the top by a little less than the width of the emargination of the eyes in front, the lower lobes slightly wider than long and strongly convex, the upper lobes small and feebly convex. Antennae two and one-half times as long as the body, dull brown, with the median joints paler basally.

Pronotum two-thirds wider than long, and slightly narrower at base than apex; sides feebly obliquely expanded to the lateral tooth at basal fourth, behind which they are strongly obliquely constricted to near the base, where they are parallel, the tooth acute at apex and extending feebly obliquely outward; surface dull, not tumid, broadly, but not deeply transversely depressed along base, coarsely, sparsely, and very irregularly punctate, and rather densely clothed with recumbent brownish and whitish pubescence, forming on the disk two more or less obsolete brown areas, divided by a longitudinal median vitta of whitish pubescence. Scutellum as wide as long, and broadly rounded behind.

Elytra two times as long as wide, distinctly wider than pronotum, with widely exposed and rounded humeri, rather strongly cuneiform, the sides feebly rounding apically to the tips, which are strongly arcuately emarginate internally, with a small tooth at the suture, and a larger and more acute tooth at the exterior angle; surface feebly transversely depressed at basal third, without discal lines, and the lateral carina feebly elevated but not acute, coarsely and irregularly punctate, the punctures rather dense basally, becoming obsolete toward the apex, but denser and more regularly placed on the sides, and rather densely clothed with recumbent brownish and whitish pubescence, the brown areas small and rounded on the median parts, much larger and more irregular in shape on the apical half, and with a rather distinct spot on disk near base.

Beneath finely, densely punctate, and rather densely clothed with short, fine, recumbent, cinereous pubescence; last abdominal segment not much wider than the fourth and broadly subtruncate at apex; anterior and middle coxae separated by about one-fourth their diameter; femora moderately clavate toward apex; basal joint of posterior tarsi about as long as the following joints united.

Length, 5 mm.; width, 1.9 mm.

Type locality.—Montserrat, Trinidad.

Type.—Cat. No. 28402, U.S.N.M.

Described from a unique male collected at the type locality June 27, by August Busck.

In general form this species resembles *aspersa* Say, but it is narrower, slightly more cuneiform, the eyes not so widely separated from each other on the top, and the markings on the pronotum and elytra more irregular in shape.

PROBATIUS DOMINICUS, new species

Female.—Form broadly elongate, subparallel, and rather strongly convex, uniformly dark reddish-brown, and rather densely clothed with brownish and whitish pubescence; beneath more reddish than above; mandibles reddish-brown at base, but becoming black toward the tips; palpi brownish-yellow.

Head slightly wider than long and feebly convex in front, deeply depressed between the antennal tubercles, which are strongly elevated and nearly contiguous at the base, the surface densely clothed with moderately long recumbent whitish pubescence concealing the punctures, and with a narrow longitudinal groove extending from the epistoma to occiput; eyes rather large, moderately granulated, deeply emarginate, and separated from each other on the top by one-half the width of the emargination of the eyes in front, the lower lobes slightly longer than wide, and the upper lobes narrow. Antennae about two times as long as the body, pale brown or luteous, with the joints slightly darker apically, rather densely clothed with fine whitish pubescence, and ciliate beneath with long erect hairs; first joint slender, subcylindrical, feebly expanded toward apex, extending nearly to base of pronotum, and subequal in length to the fourth joint, which is slightly shorter than the third.

Pronotum two times as wide as long, and feebly narrower at base than apex; sides slightly rounded, and with a large obtuse tooth just behind the middle; surface slightly convex, nearly even, with a narrow transverse basal and apical depression, a few coarse irregularly placed punctures along base and apical margin, and densely clothed with recumbent whitish pubescence, except for a longitudinal glabrous spot at middle, and more or less ornamented with dark brown pubescence at the sides and with a longitudinal arcuate vitta of the same color on each side of the middle. Scutellum elongate triangular, and narrowly rounded behind.

Elytra nearly two times as long as wide, and slightly wider than the pronotum; humeri feebly developed; sides slightly attenuate, more strongly so posteriorly, the tips separately broadly truncate, arcuately emarginate, with the exterior angle long and acute, and the interior one obtusely rounded; surface regularly convex, and each elytron feebly tumid near base, moderately, coarsely, and irregularly punctate, rather densely clothed with recumbent brownish-yellow pubescence, the pubescence more whitish along base and on a broad transverse obsolete zigzag fascia at apical third, and with numerous erect, stiff hairs over the surface.

Beneath densely, obsoletely punctate, densely clothed with long, recumbent, yellowish-white pubescence, and with numerous long, flying hairs on the sides of abdomen and legs; last abdominal segment strongly acuminate posteriorly, slightly produced behind elytra, ventral surface at apex broadly subtruncate, and the dorsal surface rather deeply angularly emarginate; prosternal process about one-fourth as wide as coxal cavities, and arcuately declivous in front and behind; mesosternum rather broad and somewhat triangular between the coxae, arcuately declivous in front, and angularly emarginate posteriorly; femora strongly and abruptly clavate apically.

Length, 13 mm.; width, 5.5 mm.

Type locality.—Dominica.

Type.—Cat. No. 28403, U.S.N.M.

Described from a unique female collected by H. W. Foote, on the Yale Expedition to Dominica during June and July, 1913.

ENEODES, new genus

Mandibles large and rather thick at base. Head equal in width to the pronotum at apex, feebly concave between the antennal tubercles, the front wider than long, and the cheeks short. Antennae rather slender, slightly longer than the body, and ciliate beneath; first joint short, robust, oblong-oval, without a cicatrix at apex, and subequal in length to the third joint, which is considerably shorter than the fourth, and the following joints gradually diminishing in length. Eyes moderately large, rather coarsely granulated, deeply emarginate, and the lower lobes as wide as long, and rounded.

Pronotum wider than long, even, regularly convex, with a long tooth on each side at the middle, the tooth bifid and the posterior part long and curved backward. Elytra rather short, elongate, subparallel, feebly depressed on disk, and strongly declivous posteriorly, the surface rather even, and each elytron with a tuft of erect black hairs near base, but without a basal crest. Legs rather short; femora strongly, abruptly enlarged apically; intermediate tibiae with a distinct groove; tarsi rather short, narrow, and the first joint of the posterior pair shorter than the following two joints united, and the tarsal claws divaricate. Mesosternum narrow between the coxae, and arcuately declivous in front. Prosternal process narrow, arcuately declivous in front and behind, and triangularly expanded behind the coxae, which are globose. Body and legs clothed with long, flying hairs.

Genotype.—Eneodes hirsuta, new species.

This genus is quite different from the other American genera of Acanthocinini, but is closely allied to *Contoderus* Thomson and *Enes* Pascoe, both of which are confined to the Malaysian region. From

both these genera it differs in having the tooth on side of pronotum bifid. *Contoderus* also differs from it in having the head wider than pronotum, with the front as long as wide, first antennal joint much shorter than the third, and the lower lobes of the eyes elongate. From *Enes* it can be separated by its shorter form, tooth on side of pronotum bifid, with the posterior part of tooth long, acute, and curved backward, and each elytron with a tuft of erect black hairs near the base.

ENEODES HIRSUTA, new species

Male.—Form broadly elongate and subparallel; above pale reddish-brown, and rather densely clothed with whitish, reddish-brown, and yellowish pubescence, with a few black markings on the pronotum; beneath reddish-brown, with a more or less yellowish tinge.

Head slightly wider than long, and nearly flat in front, strongly depressed around posterior margin of eyes, the antennal tubercles moderately elevated and very widely separated, the surface opaque, very densely punctate, and somewhat granulose, sparsely clothed with long recumbent yellowish pubescence, with numerous long, fine, erect hairs intermixed, and with a narrow longitudinal groove extending from the epistoma to the occiput; eyes strongly convex, and separated from each other on the top by three-fourths the width of the emargination of the eyes in front. Antennae yellowish-brown, with the apex of the outer joints darker, not very densely clothed with short recumbent yellowish-white pubescence, but densely ciliate beneath with long, flying hairs.

Pronotum slightly wider than long, and somewhat narrower at base than apex; sides feebly constricted near apical angles, parallel near base, and broadly rounded at middle, armed on each side at middle with a bifid tooth, the anterior part of which is very short, and the posterior part very long, slender, and curved backward; surface feebly, broadly, and transversely concave along anterior margin and base, finely, densely granulose, rather densely clothed with long recumbent brownish-yellow pubescence, which is more cinereous anteriorly, and ornamented with black markings as follows: Three small spots on median part of disk arranged in the form of a triangle, and an elongate spot placed obliquely on each side, extending from the middle to basal depression. Scutellum elongate-triangular, and narrowly rounded at apex.

Elytra two-thirds longer than wide, and equal in width to the pronotum at middle (including the teeth); humeri feebly developed; sides parallel to apical third, then arcuately attenuate to the tips, which are conjointly broadly rounded; surface irregularly punctate, the punctures coarse and dense on basal region, but becoming finer and more widely separated toward the apex, rather densely clothed

with recumbent yellowish-brown pubescence, which is darker brown on apical region, and obsoletely ornamented with yellowish-white pubescence as follows: A broad fascia extending from humeri obliquely backward to suture at middle, a narrow transverse irregular fascia at apical third, and the lateral margins from humeral angles to apex; with a small fascicle of erect, black hairs on each elytron near base, and with rows of long, erect, moderately stiff hairs.

Beneath densely, obsoletely punctate, sparsely clothed with inconspicuous recumbent pubescence, and the legs and sides of abdomen rather densely clothed with long, flying hairs; last abdominal segment very broadly rounded at apex; middle and posterior femora more strongly arcuately expanded than the anterior pair, and distinctly flattened on their ventral and dorsal surface.

Length, 4 mm.; width, 1.7 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28404, U.S.N.M.

Described from a unique male collected at the type locality March 9, by E. A. Schwarz.

EUGAMANDUS, new genus

Mandibles large and moderately robust at base. Head narrower than pronotum, flat or only feebly concave between the antennal tubercles, the front wider than long, and the cheeks short. Antennae shorter than body, and not ciliate beneath; first joint very short, moderately robust, oblong-oval, without a cicatrix, and subequal in length to the fourth joint, which is shorter than the third, the following joints shorter and nearly equal in length. Eyes small, coarsely granulated, deeply emarginate, the lower lobes as wide as long, and more or less rounded.

Pronotum wider than long, even, regularly convex, and without tubercles on sides or disk. Elytra rather short and broad, somewhat uneven, feebly depressed on disk, with or without distinct gibbosities, and strongly declivous posteriorly. Legs rather short, the posterior ones slightly longer than the anterior pair; femora feebly clavate: intermediate tibiae with a distinct groove; tarsi short, the first joint of the posterior pair about equal in length to the following two joints united, and the tarsal claws divaricate. Mesosternum narrow between the coxae, subtruncate posteriorly, and declivous in front. Prosternal process narrow, arcuately declivous in front and behind, and triangularly expanded behind the coxae, which are globose. Anterior and middle coxal cavities closed. Body and legs clothed with scalelike hairs, and without long, erect hairs intermixed.

Genotype.—Eugamandus schwarzi, new species.

This genus belongs to the tribe Acanthocinini, but does not seem to be very closely allied to any of the included genera. It differs from all the other American genera of this tribe in having the antennae distinctly shorter than the body, prothorax regularly convex and without any indications of tubercles on the disk or at the sides, and the surface clothed with short, narrow, scalelike hairs.

I take great pleasure in naming this genus and the type species after my friend, Eugene Amandus Schwarz, Bureau of Entomology, and Custodian of Coleoptera in the United States National Museum, through whose careful and energetic collecting our knowledge of the fauna of Cuba has been very greatly increased.

EUGAMANDUS SCHWARZI, new species

Form short, broadly elongate, and subparallel; above uniformly dark reddish-brown, and densely clothed and varigated with brownish and yellowish-white scalelike hairs; beneath similar to above, but not quite so densely pubescent.

Head slightly wider than long, and feebly convex in front, flat between the antennal tubercles, which are very widely separated and feebly elevated, the surface very coarsely and rather densely punctate, densely clothed with recumbent yellowish-white pubescence, and variegated with numerous small spots of brown pubescence; eyes moderately convex, and separated from each other on the top by about two times the width of the emargination of the eyes in front. Antennae three-fourths as long as the body, and strongly variegated with short brownish and yellowish-white pubescence.

Pronotum one-third wider than long, the base and apex equal in width; widest at middle, and the sides regularly arcuately rounded; surface coarsely, densely punctate, with a scalelike hair in the middle of each puncture, and densely clothed with recumbent scalelike yellowish-white pubescence, and with similar brown pubescence forming small round spots along anterior margin, and four more or less distinct longitudinal vittae extending from the base to apical third, of which the two exterior ones are the broadest. Scutellum somewhat triangular, broader than long, and broadly rounded behind.

Elytra five-sevenths longer than wide, and distinctly wider than pronotum; humeri feebly developed; sides nearly parallel to apical third, then arcuately attenuate to the tips, which are strongly obliquely truncate internally, with the exterior angle obtuse; surface with a broad depression along suture at basal third, strongly obliquely declivous from the apical third to apex, narrowly depressed along suture near apex, each elytron with a longitudinal elevation at base, two round obtuse gibbosities placed transversely at the apical declivity, and with numerous, more or less distinct, round elevations over the surface, densely, coarsely punctate, and densely

clothed with yellowish-white pubescence, with a large, brownish area at middle along lateral margin, a narrow elongate brownish-black spot on suture near apex, and with numerous irregularly placed, brownish spots in basal region and along lateral margins.

Beneath coarsely, but not very densely punctate, moderately clothed with recumbent yellowish-white pubescence, sides of abdomen brown, and the abdomen and legs variegated with numerous small, round, brown spots; last abdominal segment broadly truncate at apex; anterior and middle femora more strongly clavate than posterior pair; mesosternum with a small tubercle between the coxae, causing it to be more truncate anteriorly than in *cayamae* Fisher.

Length, 6 mm.; width, 2.75 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28405, U.S.N.M.

Described from a unique specimen collected at the type locality March 3, by E. A. Schwarz.

EUGAMANDUS CAYAMAE, new species

Form smaller and more elongate than *schwarzi* Fisher; above dark reddish-brown, rather densely clothed with brownish-white scalelike hairs, more or less variegated with dark brown, and with a rather distinct large brown spot on each side of the elytra along the lateral margin; beneath similar in color to above, but more sparsely clothed with whitish pubescence, and with a few small, round, brown spots on the abdomen.

Head considerably wider than long and nearly flat in front, feebly concave between the antennal tubercles, which are slightly elevated and very widely separated, the surface coarsely, irregularly, but not very densely punctate, rather densely clothed with recumbent whitish and dark brown pubescence intermixed, and with a narrow longitudinal groove extending from the epistoma to occiput; eyes moderately convex, and separated from each other on the top by about two times the width of the emargination of the eyes in front. Antennae three-fourths as long as the body, the first five joints more or less variegated with short brownish and whitish pubescence, and the following joints pale brown, and more or less luteous at the apex.

Pronotum about one-fourth wider than long, base and apex equal in width, widest at the middle, and the sides regularly arcuately rounded; surface feebly, transversely, and very broadly depressed posteriorly, densely and coarsely punctate, with a scalelike hair in the middle of each puncture, and rather densely clothed with recumbent dark brown and brownish-white scalelike pubescence, but not forming any distinct designs. Scutellum triangular, about as

long as wide, and broadly rounded behind, the surface densely clothed on each side with whitish pubescence.

Elytra five-sevenths longer than wide, and distinctly wider than pronotum; humeri feebly developed; sides parallel to middle, behind which they are feebly arcuately expanded, then arcuately attenuate to the tips, which are narrow, and feebly obliquely truncate internally, with the exterior angle obtusely rounded; surface with a feeble broad depression along suture at basal third, the suture slightly elevated posteriorly, rather strongly but not abruptly declivous toward apex, and each elytron feebly tumid near base, with a more or less distinct sinuate longitudinal elevation on disk behind the middle; densely, coarsely punctate, and rather densely clothed with brownish-white scalelike pubescence, with a large brownish area at middle along lateral margin, and with numerous small, more or less distinct, brown spots on basal region and along suture and lateral margin.

Beneath densely, coarsely punctate, but not very densely clothed with short, recumbent, whitish pubescence, and with a few small, brown spots on the abdomen; last abdominal segment broadly rounded or subtruncate at apex; mesosternum obliquely declivous anteriorly.

Length, 4 mm.; width, 1.75 mm.

Type locality.—Cayamas, Cuba.

Type and paratypes.—Cat. No. 28406, U.S.N.M.

Described from four examples collected at the type locality between January 19 and 28, by E. A. Schwarz.

Very little variation was found in the paratypes, but some of these differ slightly from the type in having the brown markings a little more distinct.

This species differs from *schwarzi* Fisher in being much smaller, of a darker color above, the elytra not abruptly declivous posteriorly, without gibbosities on the declivity, and the mesosternum without a tubercle between the middle coxae.

The species is named after the locality where Doctor Schwarz did most of his collecting during the early part of 1903 and 1904, and where many of the new species described in the present paper were obtained. Cayamas is situated in the Province of Santa Clara, about 15 miles northwest of Cienfuegos, and about 5 miles west of the railroad leading from Cienfuegos to Cardenas.

CYRTINUS SCHWARZI, new species

Brownish-black, and very shining: elytra with a narrow obsolete transverse testaceous fascia at basal third; beneath similar to above, except the legs, which are slightly more testaceous.

Head considerably wider than long and nearly flat in front, flat between the antennal tubercles, which are very widely separated, and scarcely elevated, the surface shining, coarsely, sparsely, irregularly, but not deeply punctate, clothed with a few long, recumbent, cinereous hairs, and with a narrow longitudinal groove extending from the epistoma to vertex, the groove being more deeply impressed between the antennal tubercles; eyes small, rather coarsely granulated, distinctly divided, and separated from each other on the top by one and one-fourth times the width of the emargination of the eyes in front, the lower lobes rounded, and the upper lobes round and very small. Antennae 11-pointed, about as long as the body, testaceous, with the apex of the joints more or less brown, and clothed with numerous short, erect hairs.

Pronotum one-fourth longer than wide, and distinctly narrower at base than apex; sides feebly expanded to near the middle, where they are slightly rounded, strongly constricted at basal fourth, then parallel to the base; surface strongly convex, smooth, shining, with a narrow transverse groove at basal fourth, sparsely, rather finely, and irregularly punctate, the punctures more or less arranged in groups, and sparsely clothed with long recumbent cinereous pubescence.

Elytra two times as long as wide, and slightly wider than the pronotum at middle; sides nearly parallel basally, broadly expanded at apical third, then strongly arcuately attentuate to the tips, which are conjointly broadly rounded; surface shining, transversely depressed on basal third, strongly convex posteriorly, the basal tubercles feebly indicated, sparsely and coarsely punctate on the basal region, but becoming entirely smooth toward the apex and along the sides, sparsely and irregularly clothed with a few long, recumbent, cinereous hairs on the basal third, and also with rows of rather long, stiff, semierect hairs.

Beneath shining, the abdomen smooth and nearly glabrous, except the last segment, which is finely densely punctate, and broadly subtruncate at apex; femora strongly, abruptly clavate near apex, with the club slightly flattened laterally.

Length, 2.2 mm.; width, 0.14 mm.

Type locality.—Cayamas, Cuba.

Type.—Cat. No. 28407, U.S.N.M.

Described from a unique specimen collected at the type locality on March 12, by E. A. Schwarz.

This minute species is allied to *Cyrtinus fauveli* described by Cameron from Haiti, but, according to the description given for that species, *schwarzi* differs from it in having the basal fascia on the elytra narrow and not covering the basal half, and the basal tubercles only obsoletely indicated.

CYRTINUS HUBBARDI, new species

Form similar to *schwarzi* Fisher, head and pronotum dark brown, the latter with the anterior and posterior margins flavo-testaceous; elytra flavo-testaceous, with a more or less distinct fuscous spot on each elytron behind the middle; beneath uniformly flavo-testaceous.

Head nearly two times as wide as long and feebly convex in front, flat between the antennal tubercles, which are very widely separated, and scarcely elevated, the surface subopaque, finely, rather densely and irregularly punctate, sparsely clothed with rather long, recumbent, cinereous hairs, and with the median longitudinal groove only obsoletely indicated on the front; eyes very small, not very coarsely granulated, distinctly divided, and separated from each other on the top by nearly two times the width of the emargination of the eyes in front, the lobes round, and the upper ones very minute. Antennæ 11-jointed, about as long as the body, flavo-testaceous, with the apex of the joints brownish, and clothed with a few long, semierect or flying hairs.

Pronotum one-third longer than wide, and slightly narrower at base than apex; sides feebly arcuately rounded from apical angles to basal fourth, where they are very strongly constricted, then slightly arcuately rounded to the base; surface strongly convex, smooth and shining on the median parts, finely obsoletely punctuate along anterior margin, feebly transversely rugose along base, with a deep transverse constriction at basal fourth, and with a few rather long, recumbent, cinerous hairs scattered over the surface.

Elytra two times as long as wide, and slightly wider than the pronotum at middle; sides nearly parallel basally, broadly expanded at apical third, then strongly arcuately attentuate to the tips, which are conjointly broadly rounded; surface shining, transversely depressed on basal third, strongly convex posteriorly, and each elytron with a distinct basal tubercle, which is armed at the apex with a single long black seta, sparsely, coarsely, and irregularly punctate on disk in basal region, but becoming entirely smooth toward the apex and along the sides, sparsely and irregularly clothed with long, recumbent, cinerous hairs on the basal half and along lateral margins toward apex, and also with rows of widely separated, long, stiff, erect hairs.

Beneath shining, with a few obsolete punctures on the abdomen, and very sparsely clothed with rather long, recumbent, cinereous pubescence, which is denser along the sides of the sternum; last abdominal segment broadly rounded at apex; femora strongly, abruptly clavate near apex, with the club obsoletely flattened laterally.

Length, 2.7 mm.; width, 0.17 mm.

Type locality.—Montserrat.

Type.—Cat. No. 28408, U.S.N.M.

Described from a single specimen collected on the island of Montserrat, March 19, by H. G. Hubbard.

This species is closely allied to *Cyrtinus schwarzi* Fisher, but can be easily separated from that species by its paler color, by the fact that the head is subopaque in front, the eyes more widely separated above, the elytra with distinct basal tubercles, the erect hairs longer and more widely separated in the rows, the abdomen more punctured beneath, the sides of the sternum distinctly pubescent, and the femora only obsoletely flattened laterally.

ESSOSTRUTHA RAMSDENI, new species

Female.—Form elongate, subparallel and slightly flattened above; head and pronotum very densely clothed with scalelike orange-red pubescence, which is slightly grayish at base, somewhat recumbent on the head, but more erect on the pronotum, which also has a large, semicircular, black spot on each side of the middle along the base; elytra densely clothed with recumbent reddish-gray pubescence, and ornamented with black markings as follows: An elongate spot extending from base to behind the humeri, not reaching the lateral margin but extending obliquely inward to middle of disk, a broad transverse fascia just behind the middle extending from lateral margin to near the suture, and broadly connected along the lateral margin to a large spot covering the apical sixth. Beneath similar to above, with the anterior parts more brownish, last abdominal segment black, and the legs more or less reddish-brown or black.

Head moderately transverse and nearly flat in front, feebly concave between the antennal tubercles, which are very widely separated and feebly elevated, the surface sparsely, coarsely, and irregularly punctate, and concealed by the pubescence; eyes large, finely granulated, nearly divided, and separated from each other on the top by about the width of the emargination of the eyes in front, the lower lobes as wide as long, and strongly convex, the upper lobes small and flattened. Antennae about as long as the body, entirely black, densely clothed with short black pubescence, and with numerous long, erect hairs on the under side of the joints.

Pronotum nearly square, apex and base equal in width, the sides nearly parallel, and only obsoletely tumid at middle; surface regularly convex, feebly tumid on disk, and coarsely, sparsely, and irregularly punctate, the punctuation being concealed by the dense pubescence. Scutellum wider than long and very broadly rounded behind.

Elytra a little more than two times as long as wide, and distinctly wider than pronotum; humeri strongly developed; sides nearly parallel to appical sixth, then arcuately rounded to the tips, which are truncate, and separately arcuately emarginate; surface slightly

flattened above, coarsely, sparsely, and irregularly punctate, the punctures concealed by the pubescence.

Beneath densely and obsoletely punctate; last abdominal segment nearly as long as the two preceding segments united, parabolic in shape, broadly truncate and feebly angularly emarginate at apex, and with an obsolete median longitudinal groove on disk.

Length, 11.5 mm.; width, 3.75 mm.

Type locality.—Guantanamo, Cuba.

Type.—Coll. Amer. Mus. Nat. Hist.

Described from a unique female received from the American Museum of Natural History, which was collected on the San Carlos Estate, at Guantanamo, Cuba, on June 18, 1910, by Charles T. Ramsden.

This is the first species of this genus to be recorded from the West Indies, the six previously known species having been described from Mexico and Guatemala.

NORTH AMERICAN TWO-WINGED FLIES OF THE GENUS CYLINDROMYIA MEIGEN (OCYPTERA OF AUTHORS)

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In the preparation of this paper the writer has studied the material contained in the United States National Museum, including his own earlier collecting; the Canadian National Collection; the University of Kansas; the California Academy of Sciences; and the private collections of C. W. Johnson, James S. Hine, A. L. Melander, H. J. Reinhard, and H. W. Allen, together with a few specimens from various other sources. The total number of specimens examined is nearly 800. Special acknowledgment is gratefully made to C. Howard Curran, who when he learned of my work turned over all the material of the Canadian National Collection with a partly prepared paper and numerous drawings. R. E. Snodgrass kindly prepared drawings of the remarkable holding apparatus of the females of *Cylindromyia nana*. Several European species determined by Prof. M. Bezzi are in the United States National Museum, and have been very useful.

The genus *Cylindromyia* was described by Meigen in his famous 1803 paper, the real beginning of dipterous taxomony. Two years later Latreille described the same genus, with the identical genotype, as *Ocyptera*. Meigen, solely out of deference to his distinguished colleague, as far as can be perceived now, waived his own priority and adopted *Ocyptera* in his next treatment of the genus in 1824. This disposition of the names was accepted for many years. Osten Sacken cited this case in his paper on Priority or Continuity? in 1882, as an illustration of the undesirable effect of too strict enforcement of priority. Professor Bezzi later argued that *Ocyptera* was included in Latreille's 1802 volume, and hence really was prior; that this was an error was not discovered until after he had published his third volume of the Palaearctic Catalogue. Coquillett, in his Type Species paper of 1910, accepted *Cylindromyia*, and was followed by Townsend in 1912.

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In the present case we have the consolation, in abandoning a well-known and long-used name, that we are going back to a classic author and a historic work, and choosing a name based on an unquestioned genotype. Even with this much in favor of *Cylindromyia*, I confess I debated the matter a long time in my own mind, and finally yielded with reluctance to what seems the logical conclusion.

Genus CYLINDROMYIA Meigen

MEIGEN, Illig. Mag., vol. 2, 1803, p. 279. Sole species, *Musca brassicaria* Fabricius.

LATREILLE, Hist. nat. Crust. et Ins., vol. 14, 1805, p. 378 (*Ocyptera*, with 3 species, of which *Musca brassicaria* was designated as type by Curtis, Brit. Ent., 1837, p. 629).

FALLÉN, Rhizomyzides, 1820, p. 5 (*Ocyptera*).

MEIGEN, Syst. Beschr., vol. 4, 1824, p. 209 (*Ocyptera*).

ROBINEAU-DESVOIDY, Myodaires, 1830, pp. 229, 231 (*Ocyptera* and *Parthenia*, the latter with 3 species, of which Coquillett designated *boscii* as type in his Type-Species, 1910, p. 585).

MACQUART, Hist. Nat. Dipt., vol. 2, 1835, p. 180; Dipt. Nord Fr., 1834, p. 215; Dipt. Exot., vol. 2, pt. 3, 1843, p. 232 (all *Ocyptera*).

ZETTERSTEDT, Dipt. Scandinav., vol. 3, 1845, p. 1219 (*Ocyptera*).

RONDANI, Dipt. Italicae. Prod., vol. 1, 1856, p. 78; vol. 4, 1861, p. 122 (both *Ocyptera*).

SCHINER, Fauna Austriaca, vol. 1, 1862, p. 412 (*Ocyptera*).

OSTEN SACKEN, Wien. Ent. Ztg., vol. 1, 1882, p. 191, says *Cylindromyia* is prior, but prefers to retain *Ocyptera*.

BRAUER and BERGENSTAMM, Zweifl. Kais. Mus., vol. 4, 1889, p. 138; vol. 5, 1891, pp. 387, 407; vol. 6, 1893, p. 143 (all *Ocyptera*).

PANDELLÉ, Revue Entom., vol. 13, 1894, pp. 32, 57 (*Ocyptera*).

COQUILLETT, Revis. Tachin., 1897, p. 86, key to North American species (*Ocyptera*); Type-Species, 1910, 529, adopts *Cylindromyia* (Proc. U. S. Nat. Mus., vol. 37).

VILLENEUVE, Wien. Ent. Ztg., vol. 22, 1903, p. 37 (*Ocyptera*, European species, with notes on Meigen's types).

VAN DER WULP, Biologia, Dipt., vol. 2, 1903, p. 449, key to North American species (*Ocyptera*).

BEZZI, Wien. Ent. Ztg., vol. 26, 1907, p. 55; Kat. Pal. Dipt., vol. 3, 1908, p. 429 (both *Ocyptera*).

TOWNSEND, Muscoid Flies, 1908 (Smiths. Misc. Colls., vol. 51, No. 1803), p. 81, notes on species (*Ocyptera*); Proc. Ent. Soc. Wash., vol. 14, 1912, p. 48, adopts *Cylindromyia*, notes on habits; Insecutor Ins. Menst., vol. 3, 1915, p. 94 (*Apinocyptera*, type *signata*, new); Journ. New York Ent. Soc., vol. 23, 1915, p. 233 (*Odontocyptera*, type *nana*, new); Insecutor Ins. Menst., vol. 4, 1916, p. 32 (*Neocyptera*, type *dosiades* Walker); Proc. U. S. Nat. Mus., vol. 49, 1916, p. 631 (*Ocypterodes*, type *cuchenor* Walker).

APSTEIN, Sitzungsber. Naturforsch. Freunde Berlin, 1915, No. 5, p. 166, lists *Ocyptera*, type *brassicaria* Fabricius, in his proposed nomina conservanda.

STEIN, Archiv. f. Naturgesch., vol. 90, 1924, p. 173, key to European species, with brief descriptions (*Ocyptera*).

The species of *Cylindromyia* are remarkably uniform in most of their characters; even those which show specializations in the female

ovipositing apparatus are in the male sex, as far as known, quite within the range of the rest of the genus. Several species show in the females some specialization tending toward a single holding hook instead of a symmetrical pair, and this is more or less associated with the development of special groups of spines on the venter. Attention is especially called to the remarkable condition in *nana* Townsend, in which one of the hooks is weak at base and regularly breaks off at an early stage in the activity of the adult female fly.

As a detailed description of all the species would consist mostly of unprofitable repetition, it is thought best to begin with the generic characters (liberally interpreted) of the type species *brassicaria* of Europe, taken from specimens identified by Professor Bezzi. After the key, each North American species is described only as far as the characters seem important for separating the species from *brassicaria* or known North American species. By this method it is hoped to save a good deal of space and yet omit nothing of significance.

Generic characters of Cylindromyia (from the type species)—head in profile almost as long as high, from front a little wider than high (length 39, height 42, width 51 units of micrometer); the lower edge long and straight, the back bulging, so that the bare eyes are in profile about as far from the back edge as from the front; front moderately wide, .30 of head width in both sexes; frontal stripe broad, of uniform width to antennae, which are inserted above middle of head, moderately long, the arista bare, with distinct but not elongated penultimate joint. Face not receding, slightly keeled above, the epistoma jutting out between the vibrissae, facial ridges bare. Parafacials bare. Palpi generally absent, occasionally present in a very rudimentary condition (in European material—I have seen but one case in the American; strangely enough this variability seems not to be even of specific value); proboscis slender but not much elongated. Verticals one large pair; ocellars one smallish pair directed forward and outward, behind the ocellar triangle another pair directed outward, and still another small pair behind these on the occiput directed upward; two pairs orbitals in female, none in male; frontals about eight, none of the upper distinctly larger and reclinate, the lowest just at insertion of antennae, the row not diverging toward the eye; bucca with only a single row of bristles along lower edge, disappearing behind.

Thorax rather narrow, barely as wide as the head, with prominent humeri, the suture behind the middle. Postscutellum distinct. Chaetotaxy: acrostichal 0, 0; dorsocentral 3, 3; humeral 2, and numerous outstanding stout hairs; posthumeral 1; presutural 1; notopleural 2; supraalar 1, stout; intraalar 2, only a little above the preceding; postalar 2; scutellum with two stout lateral pairs and a small decussate apical, no discal; sternopleural 2; pteropleural 0;

hypopleural 3 to 4; mesopleural 5 or 6 behind, one at lower front angle; prothoracic 2 (just above front coxae); prosternum bare; postalar declivity bare; postnotum at side below calypter destitute of minute hairs.

Abdomen narrow and elongate, the basal segment which in most Tachinidae is not visible from above is quite distinct though short (following custom I have ignored this in counting the segments); this short segment is without bristles; the first principal segment has a pair of median bristles not near the margin, and on each lateral margin three, one behind the other; second segment with one median marginal pair and one lateral near hind margin; third segment with marginal row of four, no laterals; fourth segment with a row of about 8, which are discal in the middle, marginal at the sides (the American are mostly marginal in the middle); fifth or first genital segment in male with one pair of small bristles projecting backward. Basal sternite of abdomen overlapping the tergites, the following sternites however concealed; second tergite with a few bristles at hind angles below near median line.

Male (fig. 1) with the usual posterior (or inner) and anterior (or outer) forceps, the former pale and much less chitinized than the latter. Female with last genital segment forming a theca or cup, open apically, where a small sting protrudes; on each side at tip the chitin is produced into a curved horn or hook, not jointed, no doubt used in holding the host during the insertion of the sting. The structure is almost identical with that of *intermedia* (fig. 25).

Legs stout, claws and pulvilli elongated in male, not in female.

Wings narrow; fourth vein with stump at bend, the last section sinuous, joining the third considerably before its apex, petiole of third vein curving forward to join the costa far before apex. Veins bare except a few hairs at base of third. Hind crossvein sinuous, joining fourth vein about last fifth of its penultimate section.

Our species, like those of Europe, separate into three groups on the bristles of the scutellum; Pandellé used these characters in 1894, and Coquillett in 1897. Our *dosiades* has a single pair of scutellars (the posterior laterals of Pandellé), while *intermedia* and *nigra* have in addition a small crossed apical pair. *Compressa*, known from a single female, has in the type only one of the apicals, hence may belong to either of the two groups. All the rest of our species have in addition to the two pairs mentioned a lateral pair near base (anterior lateral of Pandellé).

Females of our species separate into three groups on the presence or absence of groups of short ventral setules on the abdomen, on a swelling of the segment. *C. dosiades* and *compressa* have such a swelling with spinules on the first principal segment; *nana* and

signata have it on the second; while the other species do not have it at all.

We have but one species, *intermedia*, with the hind tibiae villous on the flexor side in the male; and only one species, *dosiades*, with discal bristles (both sexes).

The principal male genital organs for taxonomy are the forceps. The posterior (or inner) originate at the sides of the anus, and are usually of soft consistency. The anterior (or outer) are well chitinized, blade-like. The penis is quite simple and seems to present no tangible characters. The fifth sternite is here a delicate plate, hardly more than a membrane, and usually invisible until the genitalia have been pulled out of their cavity; it then shows important characters in the width of the median incision, etc.

The female genitalia are adapted for holding the host insect during the insertion of the sting, which is much like that of a wasp. The last segment turns up against the preceding portion of the abdomen, and in most species has two lateral terminal unjointed hooks; the presence of these and their shape are of importance in separating the species.

In the wing the sinuosity of the hind cross vein is of some importance, but most of the supposed characters are variable and I have made little use of them.

Systematic position.—Fallén was the first to attempt subdivisions corresponding to what we would now call families in the muscoid group. He separated *Ocyptera*, *Gymnosoma*, and *Alophora* (which he called *Thereva*) from his Muscides in a family Rhizomyzides (Faun. Suec., 1820). Robineau-Desvoidy (Myodaires, 1830, p. 222) proposed a group Ocypteratae, which apparently would rank between a subfamily and a tribe in the terms now used. Macquart (Dipt. Nord France, 1834, pp. 142, 212) adopted the same name; but as he greatly reduced the number of groups he in effect made this of family rank. Schiner adopted Macquart's major groups with but a slight change, having a subfamily Ocypterinae of equal rank with his Tachininae and Dexiinae. Brauer and Bergenstamm at first [1] recognized a family Ocypteridae; but later they receded from most of their family names and [2] then designated a "Gruppe Ocyptera," which they placed between "Gruppe Pseudominthoidae" and "Gruppe Micropalpus." In their third paper [3] they have a slightly extended "Sectio Ocyptera." Girschner [4] seems to have made no place for the genus, as it does not run to any of his divisions. Pandellé [5] has a subfamily Ocypterinae in his family Tachinidae.

[1] Zweifl. Kais. Mus., vol. 4, 1889, p. 138.
[2] Vol. 5, 1891, p. 407.
[3] Vol. 6, 1893, p. 143.
[4] Illust. Wochenschrift f. Ent., vol. 1, 1896, p. 111 and preceding.
[5] Rev. Ent., vol. 13, 1894, p. 28.

Bezzi [6] places *Ocyptera* in Dexiinae. Baer [7] does the same. Stein's posthumous work [8] treats all muscoids with hypopleural bristles as the single family Tachinidae, without introducing subfamilies.

In the United States, Coquillett [9] included *Ocyptera* in his Tachinidae. Townsend [10] in 1912 placed Cylindromyia in a tribe *Cylindromyiini* of the subfamily Phaniinae, family Exoristidae; he added the unique suggestion that the tribe *Compsilurini* would go in the same subfamily. In a manuscript outline of his classification, submitted quite recently, he puts the tribe *Cylindromyiini* in the family Phasiidae.

In the present paper it is proposed to consider *Cylindromyia* the chief member of the small subfamily Cylindromyiinae of the family Tachinidae. No attempt will here be made to analyze the other components of the group.

Biology.—About a century ago, Dufour observed the parasitism of the European *Cylindromyia bicolor* Olivier on the Pentatomid *Rhaphigaster grisea* Fabricius; [11] he figured adult and larva. Nielsen has given a report of some studies of his own, of *Cylindromyia brassicaria* Fabricius parasitic on another Pentatomid, *Dolycoris baccarum.*[12] He found larvæ in the first and third stages at the same time in the last of July, but only one in each host. He noted that the larva hibernates in its host in the second stage, and that it does not kill the host, even at the time of exit. It pupates in the ground. He thinks the fly is ovoviviparous (Pantel's group 9).

Caffrey and Barber, in Bulletin 779 of the United States Department of Agriculture, have noted on page 31 that they reared eight specimens of *Cylindromyia armata* (as *Ocypterodes euchenor* Walker) from adults of the Pentatomid *Chlorochroa sayi* Stal at Maxwell, New Mexico. I correct the species from one of the specimens. Townsend reported the rearing of *euchenor* by Forbes in Illinois from Acrididae and from *Leucania unipuncta;* [13] but these records may well be doubted, as all the others are from Pentatomidae.

KEY TO NORTH AMERICAN SPECIES OF CYLINDROMYIA

1. Scutellum with only one pair of bristles (fig. 17); abdomen with discal macrochaetae (widespread; *dosiades Walker*) ---------- dosiades Walker.
   Scutellum with two pairs of bristles—a small decussate apical pair and another much larger not far from them (fig. 16) ---------- 2
   Scutellum with three pairs of bristles, the additional pair being near the base at the sides (fig. 15) ---------- 4

[6] Kat. Pal. Dipt., vol. 3, 1908, p. 429.
[7] Die Tachinen, 1921, p. 157.
[8] Arch. f. Naturgesch., p. 96, 1924.
[9] Revis. Tachin., 1897, p. 86.
[10] Proc. Ent. Soc. Wash., vol. 14, p. 48.
[11] Annales Sci. Nat., vol. 10, 1827, pp. 246–260, pl. 11.
[12] Entom. Medd., ser. 2, vol. 4, 1909, pp. 76–81, figs.
[13] Psyche, 1893, p. 466.

2. Abdomen without red on sides, wholly black; front basitarsus shorter than the four following joints (eastern; *argentea* of Coquillett 1897, not of Townsend) ---------- **nigra**, new species.
Abdomen broadly red on sides ---------- 3
3. Female with distinct, symmetrical hooks on last genital segment, which are placed quite far apart; male with the front basitarsus as long as the following four joints and concave on outer side, also with hind tibia villous on inner side (widespread west and north; European) ---- **intermedia** Meigen.
Female with last genital segment compressed, pointed, without hooks; fourth abdominal segment with a pair of stout bristles near base above; male presumably without the characters just mentioned (Alberta).
compressa, new species.
4. Abdomen wholly shining, the incisures not white pollinose (Colorado).
alticola, new species.
Abdomen with very evident white pruinosity ---------- 5
5. Tibiae red; veins around discal and first posterior cells with sharply blackish borders (California, Mexico) ---------- **limbata**, new species.
Tibiae black; the dark color of the wings more diffused ---------- 6
6. A conspicuous white pollinose spot on the sclerite just above the posterior thoracic spiracle (Cuba) ---------- **bakeri**, new species.
No such spot, the sclerite shining black ---------- 7
7. Abdomen without any red; large species (Porto Rico) ---------- **atra** Roeder.
Abdomen broadly red on sides or apically ---------- 8
8. Males ---------- 9
Females ---------- 14
9. (MALES)—The posterior forceps short and greatly swollen, soft and cushion-like, but suddenly contracted into a small apical beak ---------- 10
The posterior forceps long and soft, basal half swollen, suddenly reduced at middle, the apical portion reaching almost to tips of anterior forceps (eastern, widespread) ---------- **argentea** Townsend.
Posterior forceps not as described ---------- 11
10. The fifth sternite with a wide, shallow emargination in the middle (eastern) ---------- **euchenor** Walker.
The fifth sternite with two narrow prolongations close together, forming a deep narrow notch at the middle line (Mexico City; Dominica).
uniformis, new species.
11. Both pairs of forceps yellow, shining, alike in consistency, the posterior chitinized, both pairs small and somewhat concealed by the thin yellow expanded margin of the last genital segment (widespread).
nana Townsend.
The posterior pair of forceps much less chitinized than the anterior pair, which are hard and shining ---------- 12
12. Anterior forceps very broad apically, broader than at base, subtruncate (widespread) ---------- **armata**, new species.
Anterior forceps tapering toward tip, not so wide apically ---------- 13
13. Posterior forceps short and in profile rather thick, but not strikingly swollen, about half as long as anterior ones, which are grooved behind at the bend; back of head with some black hair on each side of the occipital region above (widespread) ---------- **decora**, new species.
Posterior forceps more than two-thirds as long as anterior, which are not grooved behind at the bend; back of head with only pale hair inside the orbital row (widespread; *euchenor* of Townsend 1916).
vulgaris, new species.

14. (FEMALES)—Second principal segment underneath with a large crescent-shaped area of short stubby spines on a prominence, behind which is a concavity; terminal hooks of last genital segment unsymmetrical or only one present 15
Second abdominal segment destitute of such spiny, swollen area; hooks of last genital segment symmetrical 16
15. Large tropical species with only one genital hook, which is strikingly large; fifth and sixth abdominal segments red (Guatemala) ... **signata** Townsend.
Small, more northern species, the left genital hook deeply grooved at base if present, usually broken off; tip of abdomen shining black (widespread). **nana** Townsend.
16. The hooks on last genital segment attached below a square upper apical shoulder of the segment 17
Last genital segment without such shoulder, sloping down to the hook ... 19
17. With only 2 sternopleurals; genital hooks as in *armata* (widespread). **decora**, new species.
With 3 sternopleurals 18
18. The genital hooks pointing decidedly forward, gradually turned upward (widespread) ..... **armata**, new species.
The genital hooks turned upward from base, standing close to shoulder, the tips divaricate (widespread) ..... **euchenor** Walker.
19. Usually with only 4, sometimes with 6, bristles on tergite of fourth abdominal segment; large, common species (eastern) ..... **argentea** Townsend.
With more than 6 bristles on the tergite of fourth abdominal segment (widespread) ..... **vulgaris**, new species.

CYLINDROMYIA DOSIADES Walker

(Figs. 7, 22)

Oeyptera dosiades WALKER, List. Dipt. Ins., vol. 4, 1849, p. 695.—VAN DER WULP, Tijdschr. Ent., vol. 26, 1883, p. 15, occurs in Quebec.—GIGLIO-TOS, Ditt. del Messico, vol. 3, 1893, p. 3.—COQUILLETT, Revis. Tachin., 1897, p. 86.—JOHNSON, List Ins. New Jersey, 1899 and 1910; List Dipt. of Florida, 1895 and 1913.—HINE, Canad. Ent., vol. 36, 1904, p. 91.—VAN DER WULP, Biologia, Dipt., vol. 2, 1903.—CHAGNON, Entom. Student, vol. 2, 1901, p. 15, occurs in Montreal.—GIBSON, Entomol. Record, 1911, 1914, 1915, occurs in Canada.—VAN DUZEE, Canad. Ent., vol. 43, 1911, p. 237, occurs in Kearny, Ontario.—WINN and BEAULIEU, Ins. Prov. Quebec, 1915, p. 141.—BRITTON, Check-List Ins. Connecticut, 1920.—COLE and LOVETT, List Dipt. Oregon, 1921, p. 301.—BRIMLEY, Ent. News, vol. 33, 1922, p. 232, occurs in North Carolina.
Oeyptera euchenor TOWNSEND, Journ. New York Ent. Soc., vol. 5, 1897, p. 176 (makes *dosiades* a synonym); Psyche, 1897, p. 149.
Oeyptera euchenor, var. *dosiades* TOWNSEND, Psyche, 1898, p. 212.
Neocyptera dosiades TOWNSEND, Insecutor Ins. Menst., vol. 4, 1916, p. 32.

The species has the usual red or yellow areas on the sides of the abdomen, leaving a rather wide median black stripe, and the whole posterior end of the abdomen shining black.

The male has the posterior forceps entirely united, brown and enlarged at base, where they bear a tuft of black hair; apically they run out in a long yellowish point, slender in profile, grooved behind,

nearly as long as the anterior forceps; the latter are shining black, moderately slender, gently curved to a rounded apex. The sides of the last genital segment project in a thin yellow process along the side of the cavity containing the genital organs.

In the female the last abdominal segment is in the form of a deep spoon with a deep median notch in its apex, from which the sting usually projects; there are no hooklike processes on the segment.

The type of *dosiades* from Nova Scotia is in the British Museum. The species is quite recognizable from the description, and I am assured by Maj. E. E. Austen that we have it correctly identified (as *dosiades*, he is not responsible for the synonymy). Sixty-eight specimens before me of both sexes show the following distribution:

In National Museum.—Vicinity of Washington, District of Columbia, including adjacent Maryland and Virginia, 14 specimens collected by McAtee, Walton, Knab, Rohwer, Barber, Greene, Myers, Jackson, and Aldrich; others from Bar Harbor, Maine (C. W. Johnson); White Mountains, New Hampshire (Morrison); base of Mount Washington, New Hampshire (Townsend); Wilmington Notch, Adirondacks, New York (Aldrich); Oswego, New York; Harrisburg, Pennsylvania (Walton); La Fayette, Indiana (Aldrich); South Georgia (Morrison); Minot, North Dakota, and Moscow, Idaho (Aldrich); Lindsay, California (McGregor); Rampart, Alaska, "through B. Preston Clark." The last locality is almost at the Arctic Circle, on the Yukon.

In the Canadian National Collection.—Oliver, British Columbia (Garrett); Agassiz, British Columbia (Glendenning); Banff, Alberta (Garrett); Aylmer, Quebec (Miss G. Beaulieu); Ottawa, Ontario.

In Professor Melander's collection (all collected by him except as noted): Woods Hole, Massachusetts; Lyndon, Vermont; Chicago, Illinois; Moscow and Chatcolet, Idaho; Perma, Montana; Pullman, Seattle, and Lake Cushman, Washington; Stanford University, California (Mann); Pullman, Washington (Mann).

In Professor Hine's collection.—Pelee Island, Ontario (Gaige); Kaslo, British Columbia (Osburn); Winona Lake, Indiana.

In H. J. Reinhard's collection.—Ohio (Reinhard).

Two specimens in Professor Melander's collection (Waubamic, Ontario and Almota, Washington) have no discals on the second and third segments; one specimen from Laggan, Alberta (Osburn, in Hine's collection), and one from Colorado, have the regular pair of small decussate apical scutellars occurring on other species of this genus; and one specimen from Bottineau, North Dakota (Ainslie), has the head unusually long on its lower edge. With the available material I do not consider these aberrations specific.

CYLINDROMYIA COMPRESSA, new species

(Fig. 23)

A small species of ordinary appearance, known only in the female, and having very unusual egg-laying apparatus. Parafacials and parafrontals silvery, the former a little wider than the third antennal joint. Antennae black, rather small, the second joint considerably more than half the third. Sternopleural two. Scutellum with one large pair of bristles near the apex, between which in the single specimen there is an apical bristle on one side but not on the other. First and second abdominal segments red except the base of first and a very little of the apex of the second above. The first has only two lateral bristles, one near the base, the other near the hind edge. No discals except a pair near the base on fourth segment. On the median line below the ends of the first principal tergite seem to fuse together behind, and in this region bear about 20 distinct small spiny bristles on a slight swelling. In profile the venter of the second segment is a little concave. The third and following segments of abdomen are shining black. The third segment below with a median groove for the reception of the tip of the last genital segment; this groove continues on the fourth segment where it is mostly filled up by a globose shining black median sclerite; fifth segment contracted and tapering; sixth segment rather long, compressed, curved, shining black, drawn out into a sharp upturned point as viewed in profile; the point is composed of two blade-like portions divided below for some distance and between them the sharp sting projects. Front tarsi with a slight widening of the last three joints. Wings with rather uniform smoky coloration, more yellow in the costal cell and at base.

Length, 7.6 mm.

Described from a single female specimen taken at Banff, Alberta, by C. B. D. Garrett.

Type in the Canadian National Collection.

This species is most nearly related to *dosiades*, in which occasionally the discals are partly absent. Whether *compressa* normally has one pair of scutellars or two can not be decided from the single specimen, in which the apical pair is represented only by a bristle on one side. Both of these species have in the female a swollen, spiny area on the venter of the first abdominal segment, not the second as in *signata* and *nana*; they also have no hooks on the last genital segment. There is no doubt of the distinctness of *compressa* however, as the last genital segment is much more acute and compressed than in *dosiades*.

The European *interrupta* Meigen is very much like this species, as I note from a female in the Canadian collection kindly sent me for study. It has discal abdominal bristles however.

CYLINDROMYIA NIGRA, new species

(Figs. 10, 32)

Ocyptera argentea TOWNSEND, Coquillett, Revision Tachin., 1897, p. 86 (misidentification).—JOHNSON, Cat. Ins., New Jersey, 1899 and 1909.—BANKS, Ent. News, vol. 23, 1912, p. 110.—BRIMLEY, Ent. News, vol. 33, 1922, p. 24 (*argentata*, a slip of the pen).

A small species easily distinguished by the characters in the key. The vertex is shining, and the parafacials and parafrontals have smooth pale yellow pollen: the parafacials are rather narrow, and the frontal stripe is narrower than one parafrontal in its middle. Antennae black, but the tip of second joint and base of third reddish; third joint one and one-half times the second. In profile the eye is nearer the front than back of the head. Bucca about one-eighth of the eye.

Thorax black, the silvery pollen of the sides extending upon the dorsum to include the presutural bristle.

Abdomen wholly black, the white pruinose bands arcuate, so as to include a little of the back edge of the first and second segments at the middle, and also extending upon the venter. First principal segment with only two bristles on the lateral margin; fourth segment without bristles except one on each side.

Wings brown, fourth vein generally not with stump at bend, the apical cell wide distally; hind crossvein straight, almost erect.

Male.—Second principal abdominal segment with a cluster of four spines at the median line below, on the inflexed tergite before its posterior edge. Posterior forceps united to tip, of soft texture, basally brownish, apically whitish and swollen, as long as anterior ones, which are shining brown and end in a sharp point on the anterior edge.

Female.—Abdomen uniformly keeled below to middle of third segment, the second without distinct ventral depressed bristles. Last genital segment with very distinct terminal hooks rather close together, their tips turned a little toward the segment.

Length, 5.5 to 6 mm.

Described from 32 specimens of both sexes. In the United States National Museum are 16 specimens collected in the District of Columbia and adjacent Maryland and Virginia, by Knab, Barber, McAtee, and Shannon. Two specimens from Chesapeake Beach, Maryland (Aldrich), include the allotype female. Others are from Baltimore, Maryland (Barber); Mechanicsburg, Pennsylvania (Walton); Delaware County, Pennsylvania (Johnson); Westville, New Jersey (Johnson); Wenonah and Trenton, New Jersey (Harbeck); New Haven, Connecticut (H. B. Kirk).

In C. W. Johnson's collection are specimens from Waltham, Massachusetts, and Orange Mountain, New Jersey, both collected by Johnson.

In Professor Hine's collection are specimens from District of Columbia, and one from Newark, Ohio, all collected by Hine.

In Mr. Reinhard's collection are specimens taken by him at College Station, Texas.

In the American Museum of Natural History is a male from Cuba, "7 K. north of Vinales."

Type.—Male, Cat. No. 28279, U.S.N.M., from Glencarlyn, Virginia.

Allotype from Chesapeake Beach, Maryland.

CYLINDROMYIA INTERMEDIA Meigen

(Figs. 2, 25)

Ocyptera intermedia Meigen, Syst. Beschr., vol. 4, 1824, p. 212.—Schiner, Fauna Austr., vol. 1, 1862, p. 416.—Villineuve, Wien. Ent. Ztg., vol. 22, 1903, p. 40.—Stein, Arch. Naturgesch., vol. 90, 1924, p. 176.

Ocyptera excisa Loew, Dipt. Beitr., vol. 1, 1845, p. 19.—Pandelle, Rev. Ent., vol. 13, 1894, p. 62.

Ocyptera californica Bigot, Ann. Soc. Ent. France, 1878, p. 42.—Brauer, Sitzungsber, Kais. Akad. Wiss. Wien, vol. 107, 1898, p. 1, note on type.

This well marked European species is very common in the western part of the United States, from about the Great Plains, and in Canada extends much farther east. I identified the species by Stein's recent paper and also by careful comparison with a pair from Europe identified by Professor Bezzi. The genitalia of both sexes were compared.

The species is the only one having the hind tibia villous on the flexor side in the male and also having in the same sex a very characteristic structure of the front basitarsus, which is concave on the outer side before the middle and considerably longer than usual. The species is like *nigra* in having only one large lateral pair of bristles on the scutellum and a small apical pair. It has the abdomen more broadly red than any other species, at least on the average, the second principal segment being usually without any black color. It was this peculiarity which led me to suspect that *californica* Bigot is the same species. J. E. Collin kindly examined Bigot's type with reference to some of the points and his statements seem to prove that my surmise was correct.

The venter is silvery pollinose next the eye, and the parafrontal and parafacial are also; the latter is rather wide, almost twice as wide as the slender third antennal joint. The antennae are more or less red from the base to the vicinity of the arista. The sides of the thorax are silvery pollinose up the posthumeral bristle and there is a very distinct narrow silvery median stripe reaching about to the suture. The second principal segment of the abdomen in the male has on the under side next to the median line two or three small appressed bristles on each side on the hind corner of the tergite.

The fifth sternite (so retracted that it is usually invisible without spreading) has a narrow notch in the middle. The posterior forceps in the male are united, brown in color, rather short and of equal width in profile, with a minute apical tooth on the anterior side. The anterior forceps are shining brown, considerably longer, straight, and at the tip broadly curved forward to a rather sharp point. The lateral margin of the last genital segment forms a slender almost fingerlike small yellow process on each side. In the female the last genital segment is reddish toward the apex with a broad terminal opening, on each side of which a strong hook curves forward and upward, but not situated so as to form a deep notch with the body of the segment. The ventral side of the abdomen is smooth and regular without cluster of spines. The front tarsi of the female are noticeably elongated and flattened, the same also in the European specimen.

Length, 8 to 10.5 mm.

Described from 97 specimens, of both sexes, besides a male and female from Europe (Bezzi).

In the National Museum: Edwall, Fishtrap Lake, and Pullman, Washington; Moscow and Lewiston, Idaho; Lafayette, Indiana (all the preceding collected by Aldrich); Peaceful Valley, Colorado (Cockerell); Louisville, Colorado (M. H. Perkins); Bonaparte Lake, Okanogan County, Washington, and Bead Lake, Newport, Washington (Lane); Priest Lake, Idaho (Piper); Reno, Nevada (Wickham); Elkhorn Mountains, Montana (Mann); Shields River, Montana (Hunter); Eagle Creek, Oregon (Melander); Kaslo, British Columbia (Osburn); Beach, North Dakota (Ainslie); Denver, Colorado (Dyar and Caudell); Owl Creek Mountains, Wyoming (Currie); Walnut Creek, California (Davidson); Claremont, California (Baker); Pasadena, California (Grinnell); Koehler, New Mexico (Walton); Texas (Belfrage).

In the Canadian National Collection: Sudbury, Ontario, July 7, 1889; Lethbridge, Alberta (Seamans, Strickland); Aweme, Manitoba (Vroom, Robertson); Fort Wrigley, McKenzie River (C. H. Crickmay); Waterton Lakes, Alberta (McDunnough); Osoyoos, British Columbia (Garrett); Lillooet, British Columbia.

In Kansas University: Washington Territory; California (Baron); Estes Park, Colorado (Snow); Clark County, Kansas (Snow); Reno, Nevada (Hillman); Douglas County, Kansas (Snow); Ellis County, Kansas (Williams); Johnson County, Kansas (Beamer).

In Professor Melander's collection: Pullman, Washington; Mount Moscow and Priest Lake, Idaho; Eagle Creek, Oregon (all preceding collected by Melander); Almota, Washington (Yothers); Torrey's Lake, Wyoming, September 7, 1895 (Wheeler).

In Professor Hine's collection: Kaslo, British Columbia (Osborn); Amidon, Slope County, North Dakota, and Stump Lake, Nelson County, North Dakota (Hubbell).

CYLINDROMYIA ARGENTEA Townsend

(Figs. 3, 27)

Ocyptera argentea TOWNSEND, Proc. Ent. Soc. Wash., vol. 2, 1891, 144.

As this species was misidentified by Coquillett in his Revision, 1897 (p. 86), and other writers followed him, there are several erroneous references in the literature, now belonging to *nigra*, new species. Townsend in his original description mentioned three males from District of Columbia and a female from Iowa. I examined the three male types at the University of Kansas; the female was not there. Two of the males are the species herein described: the other is *euchenor* Walker. As I spread the genitalia, and the characters are very distinct, there is no doubt whatever about this conclusion. I restrict the species by excluding *euchenor*. The two species are the largest and most robust of the genus in the nearctic region, as far as known.

The species agrees in size and most characters remarkably with *brassicaria*, but has a wider and darker abdomen. The red on the sides of the abdomen is not sharply defined, and the broad, changeable and rather vague white or silvery pruinosity helps to conceal the change of ground color. In most of the specimens of both sexes the fourth principal segment bears only two pairs of marginal bristles, although in some cases there are three. This seems to be a very good character for separating the females from related species. There is usually a distinct third sternopleural bristle below the anterior. The parafacial is considerably wider than the widest portion of the third antennal joint. The face has a considerable keel above and is decidedly concave in profile on the lower part. The fifth sternite has only a shallow median excision, the two sides of which bear erect spiny hairs in a minute comb beginning a little distance from the middle. The posterior forceps are long, united to tip, very soft in structure, pale yellow or whitish in color, with a considerable enlargement at the base, suddenly diminishing at middle. The tip is closely applied as usual to the anterior forceps, reaching almost to their extremity. The anterior forceps are shining black, grooved at the bend, and curved forward somewhat irregularly from near the base with a rather blunt point, which seems variable as in other grooved forms from becoming a little twisted in drying. We have no other species at all close to this. The last genital segment of the female is globose, with the usual two symmetrical hooks

which are small and turned up very close to the apical angle in profile. It does not have any groups of short spines below.

Length, 9 to 11.5 mm.

Redescribed from 156 specimens of both sexes.

In the National Museum: Fifty-nine specimens from District of Columbia and adjacent Maryland and Virginia, collected by McAtee, Jackson, Viereck, Quinter, Greene, Shannon, Rohwer, Clemons, Aldrich, Crawford, Townsend, Knab, and Walton; 7 from Harrisburg, Pennsylvania and vicinity (Walton); others from Chesapeake Beach, Maryland (Townsend); Tazewell, Virginia (Jackson); Calhoun F., South Carolina (Titus); Miami Beach, Florida (Snyder); Tennessee; Lafayette, Indiana (Aldrich); Marion County, Indiana (Dietz); Algonquin, Illinois (Nason); Mound, Louisiana (Jones); Onaga, Kansas (Crevecoeur); Dallas, Texas (Jones); Wolf City, Texas (Bishopp). In all 80 specimens.

In the Canadian Collection: Eleven from Teulon, Manitoba (Hunter); 1 from Pelican Lake, Manitoba (Criddle); 1 from Fort Coulonge, Quebec; 3 from Lawrence, Kansas (Curran).

In the Kansas Collection: Atchison, Douglas, Leavenworth, Lyons, Chase, Johnson, Coffey, Marion, Smith, Allen, and Osage Counties, Kansas, collected by Beamer, Bare, Breaker, Brown, and Darby; Brookings, South Dakota (Aldrich); Ames, Iowa; Knoxville, Tennessee (Summers); Canada; Illinois (Forbes); District of Columbia. In all 56 specimens.

In Professor Hine's Collection: Five specimens from Vinton and Ira, Ohio (Hine); and Newark, Ohio (Osburn).

CYLINDROMYIA EUCHENOR Walker

(Figs. 8, 31)

Ocyptera euchenor WALKER, List. Dipt. Brit. Mus., vol. 4, 1849, p. 695.
Ocypterodes euchenor TOWNSEND, Proc. U. S. Nat. Mus., vol. 49, 1916, p. 631.

Townsend designated *euchenor* Walker as type of his genus Ocypterodes; the specimen so labeled by him belongs to the species herein described as new under the name *vulgaris*. For *euchenor* as reared from a Pentatomid by Caffrey and Barber, see *armata*.

The species here selected as the true *euchenor* is the one agreeing with the type, as made out by Major Austen from my key and some numbered specimens that I sent him (his letter October 14, 1923).

It is strikingly similar to *argentea* in almost every detail, but easily recognizable by the male genitalia and the females can also be separated without any difficulty. In the male the posterior forceps are soft and swollen, subglobose, almost white, with a minute beak on the anterior side at the tip, between the anterior forceps. The soft cushionlike swelling of the posterior forceps is very remarkable. There seems to be no separation between the forceps

although there is a deep groove. The anterior forceps are shining brown, large, considerably curved forward toward the apex and they have on the posterior and inner edge a groove beginning at the tip of the posterior forceps and extending nearly to their own apex. The thin margins of this groove curve slightly up or down, considerably changing the shape of the organ. The fifth sternite has a wide excision, with a cluster of hairs each side, and outside of this another excision beyond which are about three bristles. This is practically the same in *argentea*. The female can be distinguished by the character given in the table—the terminal hooks of the last genital segment being attached below a square shoulder with which they are nearly parallel in profile. There are no special groups of spines on the venter.

Length, 9 to 11.5 mm.

Redescribed from 35 specimens, of both sexes. Of these 26 are in the National Museum, including 16 from the District of Columbia and adjacent parts of Maryland and Virginia, collected by Townsend, Currie, Quinter, Shannon, Crawford, and Walton. The rest are from Franconia, New Hampshire (Townsend); Ohio (Reinhard); Union Springs, New York (Anderson); Clementon, New Jersey (Johnson); White Springs, Florida (Townsend); College Station, Texas (Reinhard); Galveston, Texas (Trotter); Boulder, Colorado (Cockerell).

In C. W. Johnson's collection are five specimens, from Provincetown, Massachusetts (Morse); Durham, New Hampshire (Bridwell); Manomet, Massachusetts (Johnson); Monmouth, Maine (Frost), and Wellesley, Massachusetts (Morse).

In Professor Hine's collection are three specimens, from Hinckley, Ohio (Hine); Bluffton, Indiana (Williamson), and Golden, Colorado (Hine).

In the California Academy of Sciences is one specimen from San Marcial, Socorro County, New Mexico (Duncan).

In the University of Kansas collection are 9 specimens, from Connecticut (Williston); Illinois (Forbes); South Illinois; Ithaca, New York; Ames, Iowa; Pennsylvania; Minnesota, and Galveston, Texas (Snow).

CYLINDROMYIA ALTICOLA, new species

(Figs. 13, 24)

The only North American species at present known in which the abdomen is entirely shining without any pollinose markings. Frontal stripe decidedly red, at the middle about three times as wide as either parafrontal, the latter and the parafacial silvery; the parafacial at narrowest is hardly wider than the third antennal joint.

Antennae rather small, blackish, the arista short. Thorax black, with a distinct pollinose spot on the humerus extending almost to the suture, and on the sides with silvery pollen on all of the coxae and extending vaguely above the first and second ones. Sternopleural 2, with an additional small one on one side in 1 male. Abdomen broadly dark red on the sides. Wings rather narrow, evenly infuscated from front to back; the fourth vein with a long branch at its bend, its last segment far from the apex of the wing.

Male.—Claws and pulvilli all elongated, second principal segment of the abdomen a little swollen along the median line below, the third segment with a flattened V-shaped opening toward the genitalia. Genital segment blackish, the hind forceps united, of rather soft texture, deeply grooved behind, straight almost to the apex, where they bend sharply forward and are not very sharp. Anterior forceps concealed by a long swollen yellow lobelike expansion of the side of the last genital segment, so that only the tips, which are strongly bent forward and rounded, not sharp, are visible. Front tarsi plain.

Female.—Front tarsi elongated and distinctly flattened beginning with the second joint. The second principal segment of the abdomen a very little swollen on the under side, somewhat less than in the males. The genital segments black, the last one ending with a rather square shoulder which bears an almost imperceptible tooth, there being no hooklike structure developed.

Length, 6 to 7 mm.

Described from two males and two females collected at Marshall Pass, Colorado, by the writer on July 28, 1908, at an altitude of 10,856 feet.

One of the females possesses very minute but unmistakable palpi.

Type.—Male, Cat. No. 28280, U.S.N.M.

CYLINDROMYIA NANA Townsend

(Figs. 14, 19, 20)

Odontocyptera nana TOWNSEND, Journ. New York Ent. Soc., vol. 23, 1915, p. 233, female.

The parafrontals and parafacials silvery, the brown frontal stripe about as wide in the middle as the width on both sides combined. Parafacial almost twice as wide as the third antennal joint; the position of the eye a very little more vertical than usual. Thorax with considerable silvery pollen, viewed from behind there is a broad black stripe outside the dorsocentrals before the suture and a slender stripe on the inner side of the same bristles which does not reach the suture. The abdomen varies a good deal in the amount of pollen that it shows and the red portion varies in extent but tends

to cover most of the second and third principal segments. Sometimes the median black stripe is absent.

Male.—Last genital segment varying from red to black, the posterior forceps yellow, shining, apparently united, ending in a sharp point; outer forceps of the same color, rounded at tip, straight. Margin of last genital segment thin and shining yellow, projecting about as far as the tips of the posterior forceps in a broad lobe; penis longer than usual, slender in the middle, enlarged apically; fifth sternite so retracted as to be practically invisible.

Female.—The first principal segment of the abdomen bears four bristles on the hind edge where the corners come together at the middle of the venter, the second segment on the median ventral portion has a transverse protuberance somewhat arcuated, bearing numerous, very short, stiff spines. The third segment has an oval basin-shaped concavity on the middle ventral line into which the hook folds; the fifth apparent segment of the abdomen is elongated and conical, covered with short, retrorse hairs; the terminal genital segment is small, composed chiefly of the elongated hooks, which are unsymmetrical in shape, the left one being strongly constricted at the base, bulging beyond this region; the right one is stout at the base and the cavity which ordinarily lies in a symmetrical position between the two hooks is in this case thrown up along the side of the larger hook. Townsend's type specimen and one from Southern Pines, North Carolina, are the only females we possess that have two hooks; 15 other females differ only in having the left hook broken off at the base, the fractured portion is exceedingly slender and lies along the edge of the median cavity, the stinglike ovipositor so characteristic of this group lies in a groove along the side of the remaining, or right-hand hook.

Length, 5.5 to 8 mm.

Redescribed from 46 specimens (29 males, 17 females). H. J. Reinhard collected 20 males and 12 females at College Station, Texas, and this lot enabled me to feel certain that the two sexes belong together. In Professor Melander's collection are 2 males from Wawawai, Washington, collected by him.

In the Kansas collection are 3 males from Santa Rita Mountains, Arizona (Snow).

The remainder are in the National Museum as follows: 1 female with both hooks, the type, collected by Townsend at Head of Rio Piedras Verdes, Sierra Madre, Chihuahua, Mexico; 1 female, with both hooks, Southern Pines, North Carolina (Manee); 2 females, Claremont, California (Baker); 1 male, 1 female, Moscow, Idaho (Aldrich); 1 male, Lewiston, Idaho (Aldrich); 1 male, Devil's River, Texas (Bishopp); 1 male, Kerrville, Texas (Pratt).

CYLINDROMYIA ATRA Roeder

(Figs. 11, 29)

Oxyptera atra RÖDER, Stett. Ent. Zeit., 1885, p. 344.—VAN DER WULP, Biologia, Dipt., vol. 2, 1903, p. 450.—GIGLIO-TOS, Ditt. del Messico, vol. 3, p. 3, 1894 (Mem. R. Accad. Sci. Torino, ser. 2, vol. 44.)
Oxyptera minor RÖDER, Stett, Ent. Zeit., 1885, p. 344.

A large shining black species without red on the abdomen. Three sternopleurals. Abdomen with two silvery, pruinose cross-bands, the posterior one including most of the third segment; fourth segment shining black with eight bristles.

Male.—Fifth sternite with a narrow excision in the center, on each side of which is a slight prolongation followed by an emargination, beyond which at the side are a couple of flattened spines; second principal tergite of the abdomen with two or three pairs of long depressed bristles at the hind corners below next to the median line. Genital segments dark brown or black. Posterior forceps united, soft, deeply grooved behind in profile, of uniform width almost to their tip, then drawn out in a point on the anterior edge. Anterior forceps shining brown, rather broadly and evenly curved forward with a rather sharp apex.

Female.—Similar to male, the abdomen in profile rather deeper, not provided with a special group of short spines. Genital segments shining black, the last one piceous on the upper side, sloping rather gradually toward the hooks which are large and long, moderately divergent and curve gently forward. Front tarsi not perceptibly flattened.

Length, 9 mm.

Redescribed from 1 male from Porto Rico (W. V. Tower) in the United States National Museum, and 1 female from the American Museum of Natural History, collected at Barros, Porto Rico.

CYLINDROMYIA BAKERI, new species

(Fig. 5)

Male.—Very similar to *atra*, but readily distinguished by the character given in the table. In the single specimen the abdominal bands are narrower and more sharply defined, especially the posterior one. The genital segments are brown, the posterior forceps of the same color are chitinized, very short and rather bluntly pointed. The anterior forceps are shining brown and broader on the basal part than in any other known species. They are bent but little forward and have a broadly rounded apex; the fifth sternite is rather broadly emarginate in the middle and deeply excavated outside of this.

The female is unknown, but I have ventured to assume that it can be distinguished by a silvery spot above the posterior thoracic spiracle as in the male.

Length, 9 mm.

Described from a single specimen collected at Havana, Cuba (Baker). Named after the collector, Dean C. F. Baker, of Los Banos, Philippine Islands, as a slight recognition of his life-long activity in collecting tropical insects, and his generosity in placing his material at the disposal of taxonomists everywhere.

Type.—Male, Cat. No. 28281, U.S.N.M.

CYLINDROMYIA VULGARIS, new species

(Fig. 28)

This is a medium-sized species with brightly marked abdomen, very common through the western part of the United States, more rarely occurring in the region of Washington, District of Columbia. The red markings of the abdomen are very distinct, the median black stripe often lacking. The distinctive characters are given in the key and those of the male are most easily made out. The forceps are almost exactly as figured for *atra*. The posterior forceps are shining brown or black on the sides, widening at the apex. As usual, they are united and deeply grooved behind. In profile they are of about uniform width to the tip, where they end in a small toothlike projection closely applied to the anterior forceps. The latter are shining brown or black, the hind edge broadly curved forward, not grooved at the bend, the width nearly uniform for most of the length, the front edge curving forward beyond the middle to a rather sharp tip. The projecting edge of the last genital segment is not very prominent; the fifth sternite has a narrow notch in the center with a considerable lobe each side, beyond which there is a deep, rounded excavation, and at the lateral margin three flattened bristles of increasing size. The second principal segment of the abdomen has on the under side at the posterior corners two or three pairs of depressed long bristles. The fourth segment has about eight marginal bristles. In profile the eye is as far from the front edge of the head as from the hind edge. There are three sternopleurals in the female, the abdomen is without any characteristic cluster of ventral spines, and the depressed bristles of the hind edge of the second segment below are small and inconspicuous. The hooks of the last genital segment are large and strongly curved, but there is no square shoulder above their origin.

Length, 7 to 9 mm.

Described from 143 specimens of both sexes.

In the National Museum are 47 specimens, of which 15 are from the District of Columbia and the adjacent parts of Maryland and Virginia, collected by Greene, Currie, McAtee, Walton, Townsend, and Rohwer. The remainder are from Chesapeake Beach, Maryland (Shannon); Colonial Beach, Virginia (Silver); Michigan City, Indiana (Aldrich); Cadet, Missouri (Riley coll.); East Point,

Louisiana (Bishopp); Brookings, South Dakota, and Minot, North Dakota (Aldrich); Colorado; Denver, Colorado (Jackson); North Cheyenne Canyon, Colorado (Champlain); Binford, North Dakota (Mabbott); Quinlan, Texas (Bishopp); Austin, Texas (Melander); Socorro, New Mexico (Williston); Tempe, Arizona (Caffrey); Ormsby County, Nevada (Baker); Moscow, Idaho (Aldrich); Pullman, Spokane, and Fishtrap Lake, Washington (Aldrich); Wenatchee, Washington (Melander); Bead Lake, Newport, Washington (Lane); Vernon, British Columbia (Treherne); Yosemite, California (Westcott); Visalia and Los Angeles, California.

In the Kansas collection are 32 specimens, of which 15 are from Douglas, Decatur, Pratt, Marion, Johnson, Anderson, Clark, McPherson, Smith, and Linn Counties in Kansas; collected by Williams, Snow, Beamer, Martin, and Hoffman; the other are from Rock Creek, Kansas (Moodie); Illinois (Forbes); southern Illinois (Robertson); Santa Rita Mountains, Arizona (Snow); Bailey, Colorado; Montana; California and Washington Territory.

In H. J. Reinhard's collection are 23 specimens from College Station, Texas, and 3 from Dallas, Texas, all collected by himself.

In the California Academy of Sciences are 25 specimens, of which 21 are from localities in California—Yosemite Valley, Strawberry Valley, Vivian Park, Clayton, Mineral King, Davis Creek, Buck Creek, Mendocino County, Stockton, Panoche Hills, and San Diego, collected by Van Duzee, Van Dyke, Fox, Leach, and Blaisdell. The other four are from Garfield, Logan, and Salt Lake City, all in Utah, and collected by Van Duzee.

In C. W. Johnson's collection are two specimens; 1 from Stamford, Connecticut (Morse), the other from Cranbrook, British Columbia (Garrett).

In the Canadian collection are 8 specimens, all from British Columbia, as follows: Victoria, William Head, and Saanich District (all by Downes); Vernon (Cutler); Oliver (Vroom, Buckell); Penticton (Treherne); Lillooet (Anderson).

Type.—Male, Cat. No. 28282, U.S.N.M., from Falls Church, Virginia (Greene); allotype female from Great Falls, Virginia (Currie).

CYLINDROMYIA DECORA, new species

(Figs. 12, 30)

This species is strikingly similar to *vulgaris*, but seems to occur more eastward and can be readily separated, at least in the male, by the characters given in the table. The second abdominal segment has rather smaller bristles at the lower hind corners. The fifth sternite is the same. The posterior forceps are more white in color, noticeably shorter and in profile thicker than in *vulgaris*. The

anterior forceps are more strongly curved forward, beginning to taper at about the middle and have on the hind edge, somewhat before the tip, a distinct groove on the inner side.

The female, if I have associated it correctly, has on the last genital segment a square shoulder on each side at the lowest edge of which a strong upcurved hook originates which is directed more forward than in *euchenor*. The presence of dark hairs on the occiput on each side of the center above seems to distinguish the species from *vulgaris*.

Length, 7 to 9 mm.

Described from 40 specimens of both sexes.

In the National Museum are 11 specimens, from Franconia, New Hampshire (Townsend); Ithaca, New York (Anderson); Fishkill, New York (Kalmbach); Ann Arbor, Michigan (Anderson); Pennsylvania (Walton); Missoula, Montana; Pollock, Idaho (Aldrich); Chevy Chase Lake, Maryland; and Mojave, California.

In C. W. Johnson's collection are 5 specimens, from Colebrook, Connecticut (Wheeler); Rutland, Vermont; Niagara Falls, New York; Delaware County, Pennsylvania; and Point Antonio, Jamaica (last 4 by Johnson).

In J. S. Hine's collection, 1, "G. W. Lake" (Osburn).

In the California Academy of Sciences is 1, from Pleyto, Mendocino County, California (Van Duzee).

In Professor Melander's collection are 3, from Waubamick, Ontario (Parish); Chicago, and Hayti.

In the Canadian collection are 6; 3 from Jordan, Ontario; the others from Ottawa, Ontario (Beaulne); Jordan, Ontario (Ross); and Osoyoos, British Columbia (Anderson).

In the Kansas collection are 13 specimens, from Barton, Ness, and Clark Counties, Kansas (Williams); Champaign County, Illinois (Snow); Illinois (Forbes); Ithaca, New York; near Lander, Wyoming (Moodie); and California; "Brooks."

In the American Museum of Natural History are 2, from Santa Rosa Island, California (Wheeler).

Type.—Male, Cat. No. 28283, U.S.N.M., from Franconia, New Hampshire; the allotype female is from Pollock, Idaho.

The females are very close to *armata*, and I fear may not all separate on the sternopleural character.

CYLINDROMYIA ARMATA, new species

(Figs. 9, 26)

Ocyptera carolinae GREENE, Proc. U. S. Nat. Mus., vol. 60, 1922, art. 10, p. 11, fig. 20, puparium.

Parafrontals and parafacials silvery, the latter much wider than the third antennal joint, the former very narrow to the vertex.

Sternopleurals three; in the male the posterior forceps are soft and rather short, somewhat thick in profile, united and deeply grooved behind, varying in color from almost white to brownish. The anterior forceps are the most characteristic feature of this species, being rather broad at base and still more so toward the apex, where they are almost obliquely truncate, with a rounded point on the front edge; the fifth sternite has a notch in the middle separating two small lobes and beyond these at the sides two or three somewhat flattened small bristles. On the venter close to the middle line there are two or three pairs of bristles on the hind corners of the tergite of the second segment. In the female the hooks at the tip of the last genital segment are directed more straight forward than in other species and there is no shoulder at their base. The abdomen is destitute of groups of special short spines on the venter.

Length, 7 to 9 mm.

Described from 26 specimens of both sexes.

In the National Museum are 13 specimens, from Bethayres, Pennsylvania (Harbeck); Rock Creek, District of Columbia (Townsend); East Falls Church, Virginia (Rohwer); Chesapeake Beach, Maryland (Shannon); Beaver Creek, Montana (Hunter); Brockton, Montana (Sperry); Boulder, Colorado (Cockerell); Pueblo, Colorado (Wetmore); Northern New Mexico (Weese); Socorro, New Mexico (Williston); Maxwell, New Mexico (Barber); Mouth of Bear River, Utah (Wetmore), and Rocky Ford, Colorado, puparium found in beet field (McMillan).

In C. W. Johnson's collection are 5 specimens, from Cohasset, Massachusetts (O. Bryant); Anglesea, New Jersey (Johnson); and Colorado (Baker).

In the California Academy of Sciences are 3 specimens, from Garfield and Saltair, Utah, and Panoche Hills, Western Merced County, California, all collected by E. P. Van Duzee.

In the Kansas collection are 5 specimens, from Douglas County, Kansas (Snow); Beaver Creek, Montana (Hunter); Creede, Colorado (Hunter); and New Jersey (Johnson).

Type.—Male, Cat. No. 28284, U.S.N.M., from Chesapeake Beach, Maryland. The allotype female is the one from Rock Creek, District of Columbia.

The puparium of the Rocky Ford specimen, a female, was figured by Greene under the name *Oeyptera carolinae*. I correct the identification from the adult.

CYLINDROMYIA SIGNATA Townsend

(Fig. 18)

Apinocyptera signata TOWNSEND, Insecutor Ins. Menst., vol. 3, 1915, p. 94.

This is a large dark, tropical species, known only in the female, which has very peculiar genitalia. Parafacials silvery, the para-

frontals slightly yellow, a double pollinose spot between the vertical bristles behind the ocellar. The front and lower part of the head appears to be yellow in ground color, the parafacial is considerably wider than the third antennal joint. First and second joints of antennae and base of third yellowish. Sternopleural two. First principal segment of the abdomen entirely black, except the very narrow hind edge above; second segment broadly yellow on each side, its ventral part strongly projecting, with numerous very short stubby spines on the swollen portion, which forms a flattened area extending back upon the following segment; third and fourth segments reddish, nearly covered with a very thin whitish pruinosity. The spines on the fourth segment become irregularly discal in the middle; the fifth segment bent forward and under the abdomen, long and conical, reddish-brown in color, covered with short, stiff, retrorse hairs; the last genital segment small on the basal portion, being mostly developed into a single, very large up-turned, curved holding organ, which is on the right side of the apical opening and has on its mesal side a very distinct groove for the reception of the stinglike ovipositor. This apical opening occupies a sloping position upon the base of the prolongation or hook, and I can see no indication of a broken off left hook, such as would occur in *nana*. It is possible, however, that such a hook may have been present when the specimen emerged. Front tarsi normal; claws and pulvilli small. Wings more yellow than brown except around the first posterior cell, from the costa to the hind crossvein.

Length, 10.6 mm.

Described from a single female specimen taken at Gualan, Guatamala, by W. P. Cockerell (Mrs. T. D. A. Cockerell).

Type.—Female. Cat. No. 19960, U.S.N.M.

The species *nana* connects this form with the ordinary typical members of the genus *Cylindromyia* so well that at least until the male is known I think it not expedient to recognize the genus *Apinocyptera*.

CYLINDROMYIA UNIFORMIS, new species

(Fig. 4)

This species is almost like *euchenor*, but is somewhat smaller and differs quite decidedly in the shape of the fifth sternite, which certainly must be a specific character. In *uniformis* the median excision of the fifth sternite is narrow, only a little rounded at its base, and on each side of it there is a rather elongated, narrow lobe bearing a few hairs. This lobe forms a rather acute angle with the margin of the sternite laterally, and this margin bears at a little distance three erect bristles of which the hindmost is the largest.

The posterior forceps are smaller and a little less swollen than in *euchenor* but of the same general pattern. The outer forceps are also smaller and a little less robust. In both species the hind edge of the forceps is grooved at the base.

Length, 6.5 to 9 mm.

Described from 2 males; 1 in the National Museum collection is from San Jacinto, Mexico, Federal District, collected by E. G. Smyth; the other in C. W. Johnson's collection from San Dominica, West Indies.

Type.—Male, Cat. No. 28285, U.S.N.M.

Paratype in C. W. Johnson's collection.

CYLINDROMYIA LIMBATA, new species

(Figs. 6, 21)

Male.—Parafacials and parafrontals slightly yellowish, the former as wide as the third antennal joint, the latter narrow above; antennae reddish-brown almost to arista. Mesonotum and scutellum with a decided brassy and metallic reflection. Sternopleurals three. Abdomen rather brownish in color throughout, the second and third segments only a little reddish on the sides; the suture between them narrowly and sharply bordered with white pollen; the third segment with the pollen much more extended; fourth segment with eight bristles; fifth segment with one strong pair directed backwards. The last genital segment mostly yellow, the genitalia greatly resembling those of *nana*, the hind forceps minute, yellow, shining, slender, about two-thirds as long as the anterior, which are also yellow and shining, straight with broadly rounded tip. The margin of the last genital segment is also shining yellow, and projects enough to partially conceal the forceps. Fifth sternite with wide and extremely shallow emargination along the center, at the sides, however, with the usual row of three bristles increasing in size on a slight prominence. Wings brown along the veins and on the anterior part. The discal and first posterior cells much lighter in the middle, the brown color following the veins with quite uniform width. Tibia rather dark red (the only species known with this character); claws and pulvilli elongated.

Female.—The specimen is teneral so that the dark border on the wing veins is only suggested. The second principal segment of the abdomen has on the median line below, just before the middle, a slight swelling with numerous small and somewhat stubby spines, much less distinct than in *nana*. The fifth segment is reddish, elongated, conical, covered with rather dense retrorse hair. The last segment consists almost entirely of the hooks, which are shining black, the right one stout at the base, slightly notched in profile

beyond the middle; the left one deeply grooved at the base as in *nana* and swollen on the outer side beyond the groove.

Length, 7 to 8 mm.

Described from 2 males and 1 female, the males from the California Academy of Sciences, were collected at Mill Creek Canyon, San Bernardino County, California, by E. P. Van Duzee. One of them is retained for the National Museum collection. The female was collected at Atencingo, Mexico, by E. G. Smyth.

Type.—Male, Cat. No. 28286, U.S.N.M.; paratype, male in California Academy of Sciences.

LIST OF DESCRIBED SPECIES OF CYLINDROMYIA FROM NORTH AMERICA, NOT HEREIN IDENTIFIED

(All heretofore mentioned under *Ocyptera* except as noted. The types will have to be reexamined before the species can be identified; in the case of *carolinae* this is impossible, as no types are in existence.)

binotata BIGOT, Annales Soc. Ent. Fr., 1878, p. 44, female.—Baltimore.

carolinae ROBINEAU-DESVOIDY, Myodaires, 1830, p. 232 (Parthenia).—Carolina.

COQUILLETT, Revis. Tachin., 1897, p. 86.—Massachusetts to California, etc. A mixture of several species; the following references are based on Coquillett's key and equally uncertain.

ALDRICH, Annals Ent. Soc. Amer., vol. 8, 1915, p. 82.—Widespread.

CREVECOEUR, Kans. Acad. Sci., vol. 20, 1906, p. 93.—Kansas.

Also reported from New Jersey, Florida, and Jamaica (Johnson); Ontario (Gibson); Quebec (Fyles, and Winn and Beaulieu); British Columbia (Hine); Minnesota (Washburn); California and Nevada (Baker); Kansas (Snow); Montreal (Chagnon); Illinois (Hart); North Carolina (Brimley); Connecticut (Britton).

dotadas WALKER, List, vol. 4, 1849, p. 694.—Jamaica.

epytus WALKER, List, vol. 4, 1849, p. 694.—Georgia.

fumipennis BIGOT, Annales, 1878, p. 43, male.—Colorado.

BRAUER, Sitzungsber. Kais. Akad. Wiss. Wien., vol. 107, 1898, p. 1, note on type.

signatipennis VAN DER WULP, Tijdsch. v. Ent., vol. 35, p. 187; Biologia, Dipt., vol. 2, 1903, p. 450, pl. 13, fig. 11.—Guerrero, Mexico.

simplex BIGOT, Annales, 1878, p. 47, female.—Mexico.

soror BIGOT, Annales, 1878, p. 46.—Mexico. (The name is preoccupied.)

BRAUER, Sitzungsber. Kais. Akad. Wiss. Wien, vol. 107, 1898, p. 1, note on type.

EXPLANATION OF PLATE

(Figures 2, 3, 7, 8, 12, 22, 31, by C. Howard Curran; 19, 20, by R. E. Snodgrass. The remainder by the author)

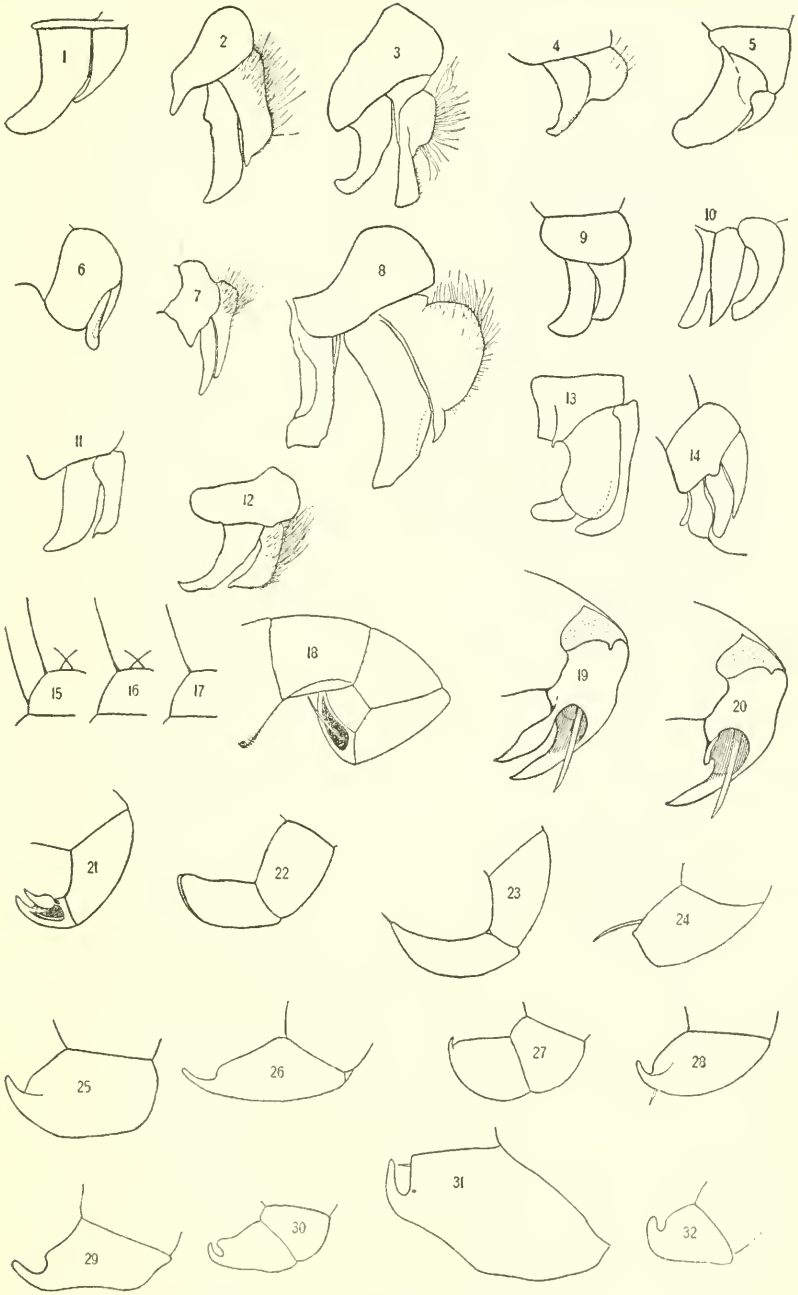
Plate 1

(Figs. 1–14 are male genitalia, side view, generally only the posterior and anterior forceps being drawn. Variously magnified)

Fig. 1. *Cylindromyia brassicaria* Fabricius.
2. " *intermedia* Meigen.
3. " *argentea* Townsend.
4. " *uniformis*, new species.
5. " *bakeri*, new species.
6. " *limbata*, new species (imperfectly drawn out).
7. " *dosiades* Walker.
8. " *euchenor* Walker.
9. " *armata*, new species.
10. " *nigra*, new species.
11. " *atra* Roeder.
12. " *decora*, new species.
13. " *alticola*, new species.
14. " *nana* Townsend.
15. Scutellum with three pairs of bristles.
16. Scutellum with two pairs of bristles.
17. Scutellum with one pair of bristles.

(Female genitalia from the side (19 and 20 diagonally from below).)

Fig. 18. *Cylindromyia signata* Townsend.
19. " *nana* Townsend, with both hooks intact.
20. " *nana* Townsend, with one hook broken off, the usual condition.
21. " *limbata*, new species.
22. " *dosiades* Walker.
23. " *compressa*, new species.
24. " *alticola*, new species.
25. " *intermedia*, new species.
26. " *armata*, new species.
27. " *argentea* Townsend.
28. " *vulgaris*, new species.
29. " *atra* Roeder.
30. " *decora*, new species.
31. " *euchenor* Walker.
32. " *nigra*, new species.



DETAILS OF CYLINDROMYIA MEIGEN

FOR EXPLANATION OF PLATE SEE PAGE 27

A COLLECTION OF PLEISTOCENE VERTEBRATES FROM SOUTHWESTERN TEXAS

By Oliver P. Hay

Associate of the Carnegie Institution of Washington

In August, 1925, Dr. Mark Francis, of College Station, Texas, sent the writer a small collection of fossil teeth and bones which he had collected near the west bank of Aransas River, in San Patricio County. The locality is described as being about 1 mile north of the bridge on which the St. Louis & Brownsville Railroad crosses the Aransas. It is also about 20 miles southwest of Refugio. Nearer is a town named Sinton, and for convenience the collection will be spoken of as from Sinton. Doctor Francis wrote that the fossils were found in a deposit of sand at a height of about 4 feet above the average water level. Credit is due to Frank Low, of Refugio, for notifying Doctor Francis of the discovery of these fossils.

The following animals have been identified:

Atractosteus tristoechus?
Testudo, species indeterminable.
Alligator mississippiensis.
Megatherium mirabile.
Chlamytherium septentrionale.
Glyptodon petaliferus.
Equus complicatus.
E. littoralis?
Camelops aransas, new species.
Bison, species indeterminable.
Odocoileus, species indeterminable.
Mammut americanum.
Elephas columbi.
Ananeus orarius, new species.
A. defloccatus, new species.
Neochoerus pinckneyi, new genus.

A large garfish (*Atractosteus tristoechus?*) is represented by several scales.

The genus *Testudo* is represented by a part of a costal plate, apparently the eighth, a part of a scapula, and the head of a femur. It was a large species, inasmuch as the costal plate measures 80 mm. along the sulcus separating the neural scute from the costal scute.

The thickness of the costal plate, at about the middle of its length, is 20 mm. The femur was about the size of that of a medium-sized horse. The side-to-side diameter of the articular surface is 68 mm.; the oblique and greatest, 82 mm.

Of the alligator there is present the distal half of the right mandible and a dorsal bony scute. The jaw contains sockets, or parts of them, of 15 teeth. Near the front is the socket for what may be called the canine; this socket has a diameter of 23 mm. Behind this come sockets for 7 small teeth, and behind these 4 sockets whose diameters are 16, 20, 19, and 15 millimeters. These teeth appear to have been much larger than those of an alligator in the United States National Museum whose length is 11 feet. The jaw does not, however, appear to be much larger. From the front of the canine socket to the rear of the last one mentioned is 185 mm. The dorsal scute is 55 mm. wide and 52 mm. long.

Of the *Megatherium* there is present a part of one tooth, apparently the front half of the lower first one, and one astragalus. The width of the tooth is 32 mm. The diameter of the astragalus is 6.5 inches.

Of *Chlamytherium* (pl. 2, fig. 2) there is a part of the right side of the lower jaw containing the four hinder teeth. This row measures 90 mm. Several teeth of *Equus* are present; two little-worn right upper premolars, pm^3 and pm^4, and a last molar are identified as *Equus complicatus*. Five lower teeth may belong to the same species. A lower second premolar, much waterworn, is taken to belong to *E. littoralis;* but it may belong to *E. tau*. Its crown measures, fore-and-aft, only 23.5 mm.; its thickness is 10.5 mm. A bison is represented by a lower molar and most of the ulno-radius. These seem not to differ from the same elements of the existing bison, but it probably belonged to an extinct species. A deer, quite certainly a species of *Odocoileus*, is known from only 130 mm. of the upper part of the right hinder cannon bone. At 50 mm. below the upper end the fore-and-aft diameter is 19.5 mm.; the side-to-side diameter 13 mm. A narrow groove descends on the front face; a broad one occupies the hinder face. Of *Elephas columbi* there are present about 13 enamel plates of the rear of a tooth, but no fragment has more than 4 plates. One plate is 195 mm. high and 95 mm. wide. Apparently there were 7 plates in a 100-mm. line.

The remaining species require more extended treatment.

GLYPTODON PETALIFERUS Cope

Plate 1, fig. 1; plate 2, fig. 3

The following are the parts of a glyptodon included in Doctor Francis' collection: Five fragments of lower jaws, three belonging to right rami and two to left rami, the parts representing per-

haps three animals; three fragments of the carapace, and a complete femur.

An important part consists of two fragments of a right horizontal ramus, between which close to 5 mm. only of bone is missing. The anterior portion presents half or more of the symphysis, the lower border of the jaw, and the bottom of the sockets of 5 teeth and a part of the sixth. The hinder fragment offers the horizontal ramus as far as 45 mm. behind the last tooth; the hinder half of the sixth socket, most of the seventh tooth, and all of the eighth tooth except the summit; also a part of the ascending ramus. The length of the tooth row was originally not far from 192 mm. The first tooth is represented by only the bottom of the socket. It was shorter and narrower than the other teeth, convex on the inner face, concave on the outer, with at least one intercolumnar groove. The second was trilobate. 20 mm. long and 8 mm. wide. The remaining teeth were close to 22 and 23 mm. in length and 14 mm. in width (pl. 2, fig. 3). The forms of these teeth resemble in general those of the teeth of Burmeister's *G. asper* and *G. elongatus*[1]; and, as in the species just cited, the symphysis reaches the front of the fourth tooth. At the seventh tooth the jaw on the inner face is 65 mm. high and 40 mm. thick. On a fragment of the left side of the jaw the ascending ramus rises 130 mm. above the alveolar border.

In 1916[2] the writer described portions of a glyptodon found near Wolfe City, Hunt County, Texas, and referred the animal to Cope's *G. petaliferus*. The two specimens need to be carefully compared. As regards the skull the two specimens present, as common parts, only one tooth, the sixth, and a fragment of the jaw bearing the ascending ramus and the outer walls of the tooth sockets. The fragments of the jaw present no apparent differences. The Sinton tooth is 22 mm. long, 15 mm. wide at the rear lobe, and 13.5 mm. wide at the front lobe. The Wolfe City tooth is 20.5 mm. long, 13.5 mm. wide at the rear, and 11 mm. in front. It may be that it belonged to a smaller animal. However, it is, relatively to the length, narrower in front than the Sinton tooth in the ratio of 54 to 61. On the inner border of the front lobe of the Wolfe City tooth there is a rather deep groove; on the other tooth this groove is very shallow. It is shallow on the fifth and fourth teeth of the Sinton tooth; missing on the third and eighth.

The three fragments of the carapace belong above the pelvis. The largest piece consists of 17 polygonal dermal scutes. Its inferior surface is traversed by an elevated tract of bone from 50 mm. to 70 mm. in width which evidently was connected with the spines of the sacral vertebrae. It is rough from fracture, without indica-

[1] An. Mus. Buenos Aires, vol. 2, 1874, pl. 27, figs. 3, 4.
[2] Proc. U. S. Nat. Mus., vol. 51, p. 107, pls. 3–5.

tions of sutures. On each side of this tract, at right angles with it, is another surface which probably was connected with the ilium. Its surface resembles that of a suture. The two other fragments of the carapace also belonged above the sacrum. Away from the median line the carapace varies in thickness from 23 mm. to 27 mm. The dermal scutes vary in diameter from 36 mm. to 46 mm. (pl. 1, fig. 1). In general, they are not coössified and the borders of the fragments follow the sutures. Each scute is ornamented by a rosettelike figure. The central portion of each rosette is much larger than the peripheral parts. The groove around the central area and those radiating from it are wide and deep. On a casual view the rosettes resemble much those shown in Lydekker's work.[3] Close inspection shows differences. In Lydekker's figure the peripheral pieces of each rosette are separated from those of the surrounding rosettes by a very distinct groove. If in the Sinton specimen the groove which appears to surround the rosette is followed one comes into contact with the central area of other rosettes. In fact, the grooves which separate contiguous rosettes and which usually follow the bone sutures are nearly suppressed in the Sinton specimen. Occasionally traces of them may be found, as shown in the illustration (pl. 1, fig. 1).

In another respect the rosettes differ from those cited from Lydekker's work. In that specimen the central areas are somewhat excavated, but the peripheral areas are flat. In the Sinton glyptodon both the central and the peripheral areas are hollowed out. Each excavation of the peripherals occupies adjoining areas of two rosettes.

On comparing the carapace here described with that of the Wolfe City specimen it is seen that in the latter the central areas are often relatively smaller, sometimes hardly larger than the peripherals; also that all the areas are either flat or convex. Often, too, in the groove surrounding the central areas there may be found three or four large pores; in the Sinton animal none, one, or two. In the Wolfe City glyptodon it is observed that occasionally rosettes are found some of whose peripheral areas are not separated by grooves from those of adjoining areas.

The writer has not seen the femur which was obtained on Aransas River, but Doctor Francis sent a carefully drawn sketch of the natural size. When this is compared with the femur of the Wolfe City specimen no differences are observed. It is possible that the differences existing between the Wolfe City specimen and that found near Sinton are indicative of distinct species. Considering, however, the variability of the elements of the skull and of the skeleton, the writer believes it better to refer the specimen to Cope's *Glyptodon petaliferus*.

[3] An. Mus. La Plata, Palaeont. Argentina, vol. 3, 1894, pl. 3, fig. 2.

Two fragments of the carapace found at Sinton were presented by Doctor Francis to the United States National Museum. To these are assigned the number 11,379.

Since going to press Doctor Francis has sent a photograph of another fragment of the carapace, which presents 11 rosettes and three bones along the border. So far as can be determined these appear to be similar to those of some part of the border of the specimen found at Wolfe City.

NEOCHOERUS PINCKNEYI (Hay)

Plate 1, fig. 2; plate 6, fig. 2; plate 7, fig. 2

In Doctor Francis' collection are found a part of an upper jaw and a part of the left side of a lower jaw of a species of rodent related to the South American capybara. The lower jaw presents the premolar, the outer walls of the sockets of the two anterior molars, and a small part of that of the last molar, also the outer wall of the socket of the left incisor. The whole fragment is 122 mm. long. The three anterior teeth occupied 80 mm. of the jaw, and the whole tooth line was close to 108 mm.; that of a specimen of *Hydrochoerus hydrochoerus* at hand is 79 mm. long. The premolar appears to differ from that of the existing capybara only in size. Its length is 29 mm. on the outer border; the oblique width at the rear is close to 13 mm.

Some important differences between this jaw and that of the South American capybara are noted. In the latter there is on the outer face of the bone a broad shelf, the masseteric ridge, which furnishes attachment for the various divisions of the masseter muscle. In the existing capybara the ridge begins at the condyloid process and, expanding in its course, forms a rounded prominence beneath the premolar and subsides below the front of this tooth. In the fossil jaw (pl. 1, fig. 2) the ridge doubtless originates at the condyloid process and, pursuing its way, develops its prominence not quite so far forward as in the capybara, and the ridge subsides below the middle of the molar. As a result the front of the jaw was not so suddenly narrowed as it is in the capybara. The course of the shelf is not so straight as in the capybara, its upper border being considerably arched, and the anterior end of the muscular insertion is curved downward. The shelf is 14 mm. thick below the third tooth; only 8 mm. in the capybara.

In the capybara the coronoid process is thin and prominent, curving outward and upward and rising some 13 mm. above the alveolar border. In the fossil (pl. 8, fig. 2) it does not reach the level of the alveolar border, but extends somewhat outward and backward as merely a continuation of a ridge just below the tooth row. The incisor tooth was relatively larger than it is in the capybara, its

diameter at right angles with the width being at least 16 mm. (pl. 6, fig. 2); in the capybara, only 8.9 mm. In the latter its base is in a prominence halfway down on the inside of the jaw and opposite the rear of the first tooth; in the fossil it was as far backward but higher up, apparently below the alveolar border about one-third the width of the jaw. The length and width of the incisor can not be determined. If the proportions were as in the capybara the width was 20 mm. In front of the base of the premolar and well in front of the masseteric ridge is a mental foramen whose diameter appears to have been about 4 mm. In the capybara the foramen is only 2 mm. in diameter, and it pierces the bone somewhat behind the front end of the ridge.

The writer is indebted to Gerrit S. Miller, jr., for some important observations on this fossil. He suggests that in two respects the animal is in a more advanced stage than is the capybara. One progressive feature is found in the elevation of the rear of the incisor; the other is indicated by the reduction of the coronoid process. A less progressive feature is found in the failure of the masseter muscle to extend as far forward as it does in the capybara.

In consideration of the differences between the Sinton rodent and the existing capybara (*Hydrochoerus hydrochoerus*) it seems that the former belonged to a line of descent which had parted from that of the capybara, and that hence a new generic name is appropriate. *Neochoerus* is chosen, as suggesting the swimming habits of the animal and its relationship to *Hydrochoerus*, the first part of the name being derived from the Greek νέω, to swim, the remainder from χοῖρος, a hog.

Accompanying the mandibular ramus above described is an upper left third molar in a piece of the maxilla and a little of the palatine. The length on the grinding face is 60 mm.; the greatest width 24 mm. It is composed of 17 plates, as represented by the edges exposed on the outer face. The best-preserved plates are 36 mm. high. It appears that the palate of the Aransas River specimen was not so flat as in the capybara. In this the roof of the palate, at the middle of the hinder molar, makes an angle of 123° with the grinding surface of the molar; in the fossil an angle of 138°. At this inclination the roof rises a distance of 21 mm. to the fracture near the midline.

In 1923 the writer described a species of *Hydrochoerus* founded on a tooth discovered in the Pleistocene deposits at Charleston, South Carolina, and this he called *H. pinckneyi*.[4] Later in the same year that tooth was further described and other figures of it were shown.[5]

[4] Publ. 322, Carnegie Institution, Washington, p. 365, fig. 18.
[5] Pan. Amer. Geologist, vol. 39, p. 103, pl. 7, figs. 3–5.

From this tooth the upper molar from Texas appears to differ only in being somewhat broader, 24 mm. instead of 22 mm. It can hardly be doubted that the South Carolina and the Texas specimens belong to the same species. The name for both will be, therefore, *Neochoerus pinckneyi*. As shown in the writer's second publication cited, other teeth of probably the same species have been discovered in Florida.

CAMELOPS ARANSAS, new species

After this paper had been sent to press Doctor Francis transmitted a small box of fossils which he had just received from the Aransas locality. In this lot were a lower molar of a bison and some remains of a camel. He also sent photographs of an astragalus of *Megatherium* and of a fragment of the carapace of *Glyptodon*. These are mentioned in their proper places.

The camel remains consist of the distal end of a front cannon bone and of a part of the right side of the lower jaw with all three molars. This belonged to an old animal, the teeth being worn down to within about an inch of the forking of the roots. The wear of mastication had obliterated the fossettes. The following measurements are presented. The length and the thickness are taken on the grinding faces; the length on the midline; the height on the inner face of the teeth.

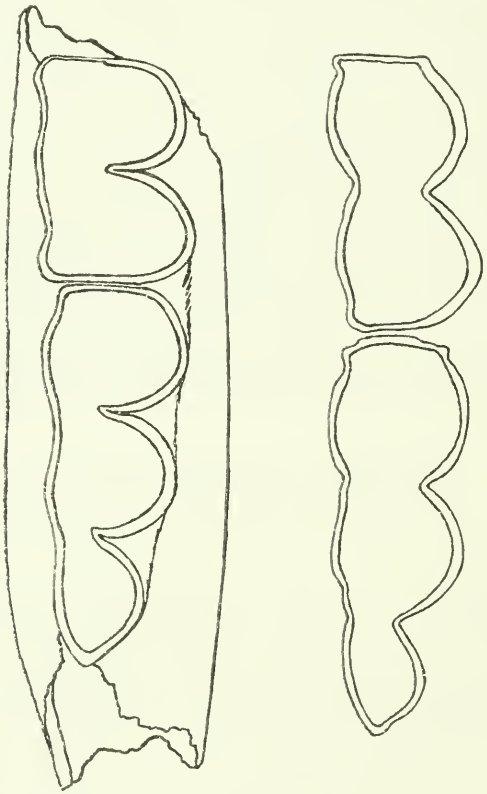
Measurements of molars in millimeters

First:	
Height	10.0
Length	28.0
Width, first lobe	17.0
Width, second lobe	21.0
Second:	
Height	20.0
Length	30.0
Width, first lobe	20.0
Width, second lobe	22.0
Third:	
Height	20.0
Length	52.0
Width first lobe	20.0
Width, second lobe	17.5
Width third lobe	12.5

The length of the row of molars is 111 mm.

These molars appear to differ from those of our other camels in the broadly rounded form of the outer faces of the lobes and in the narrowness of the valley separating them. They are in this respect more like the teeth of the Bactrian camel. The differences between these teeth and those of the camel found at Minidoka, Idaho, and now referred to *Camelops sulcatus* (*C. huerfanensis* of Hay, Proc.

U. S. Nat. Mus., vol. 46, 1913, pp. 268, 271, pl. 26). They also lack the deep groove on the inner face which separates the lobes of *C. sulcatus* and also of *C. hesternus*. These differences are brought out in the figures here presented (fig. 1, *Camelops aransas*, fig. 2, *C. sulcatus*). Considering this structure, the writer is not able to refer the jaw to any described form and he regards it as better to give it a definite name and status. It is, therefore, to be called *Camelops aransas*. It is possible that it belongs to the genus *Camelus*.



1 2

FIGS. 1–2.—SECTIONS NEAR BASE OF LOWER MOLARS 2 AND 3 OF CAMELS. 1, CAMELOPS ARANSAS; 2, CAMELOPS SULCATUS. NEARLY ACTUAL SIZE

The cannon bone probably belongs to the same species. It indicates a large animal. It measures 94 mm. across the distal end with a space of 9 mm. between the two divisions.

ANANCUS ORARIUS, new species

Plate 2, fig. 1; plate 3, fig. 1; plate 4; plate 5, figs. 1–3

The mastodon to which this name is applied is represented by the symphysis and somewhat less than one-half of both horizontal rami with a much-worn right second molar, the complete crown of

the lower right third molar, the detached lower left third molar, a detached upper left second molar—and a section of the right maxilla supporting the third molar nearly complete, these parts belonging to one individual.

The part of the lower jaw preserved is remarkably short and deep. From the front of the tooth row the profile turns downward more abruptly than is usual, even in *Mammut americanum* (pl. 5, fig. 3). The depth of the jaw at the front of the tooth row is 200 mm. The lower face of the symphysis forms an ascending curve measuring 150 mm. The hinder face rises perpendicularly a distance of 130 mm. to the lingual gutter. This gutter runs forward a little and then turns rapidly downward to meet the ascending curve of the lower face of the symphysis in the blunt beak. The length of the gutter is close to 190 mm. At its lower end it is only about 25 mm. wide, and it is nowhere more than 45 mm. deep. The lower face of the symphysis is at first flat, but it soon presents two slightly diverging keels separated by a sharp furrow (pl. 5, fig. 2). In this are seen the openings of several foramina which probably transmitted nerves and blood vessels to the lower lip.

Where the keels and the ridges bounding the lingual gutter meet there is on each side a constricted foramen which opens directly backward into the jaw and has a long diameter of 10 mm. It seems possible that these foramina represent the sockets of vestigial lower tusks; but, as shown by the somewhat injured alveolar ridges bounding the lingual gutter, a canal, which probably transmitted a branch of the inferior dental nerve, opens into the supposed socket through its roof. Possibly the lower portion of the openings is all that remains of the sockets. On Figure 3 of Plate 5 no part of the lingual groove is seen. At the right hand in the lower half of the border a part broken away exposes the canal which transmitted the dental nerve. In Figure 2 on the left side (right in the specimen) the upper dark spot represents this canal 40 mm. higher up than that taken to be a possible socket. On the side of the jaw in front of the second molar are three openings for exit of branches of the nerve mentioned.

In the collection is a detached upper left second molar which the writer refers to this species. The great front root supporting the outer end of the first crest is preserved. It has a length of 123 mm., with some part of the distal end missing. The base of the root which supported the inner end of the first and second crests remains. The crown has lost the outer half of the first valley and the adjacent part of the second crest. All three crests are worn so that in each the dentine areas of the inner and outer halves coalesced. The pretrite end of the hinder crest is, for some reason, worn deepest. Remains of a trefoil are preserved on the first crest.

The inner ends of the first and second valleys were occupied by large elongated tubercles. A pressure area is present on the front end of the crown; the talon on the hinder end was almost obliterated by the pressure of the molar behind. The crown is 122 mm. long and 93 mm. wide at the first and third crests. This tooth probably belonged to the type specimen.

The upper right third molar in its fragment of the maxilla is practically complete (pl. 3, fig. 1; pl. 4, fig. 1; pl. 5, fig.1). However, the inner half of the pretrite portion of the third cone was lost in collecting the tooth and the distal ends of the hinder portion of the rear root are broken off. The grinding face is worn as far back as the fourth crest. The length of the crown is 202 mm., measured on the midline. The width at the first crest is 102 mm.; at the second, 105 mm.; at the third, 100 mm.; at the fourth, 90 mm.; at the fifth, 68 mm. At the rear is a small talon of 3 tubercles. The outer cones of the crests are wedge shaped, and the enamel figures resulting from wear are elongated in the direction of the crest. As shown on the third and fourth crests, each outer cone terminates in 4 conules. On the hinder face of the first outer cone near the midline, is an area of dentine on the point of being connected with the dentine of the main area of wear. A large, worn-down tubercle in the valley at the midline presents another area of dentine. Near the midline, at the base of the hinder face of the second outer cone, is a similar area of dentine. These remains of buttresses would each in time have had its dentine area joined to that of the principal cone. On the inner half of the first, second, and third crests are well-developed trefoils. On the hinder face of the fourth crest the buttress is wanting. The basal lobes of the trefoils are pointed. This appears to have been produced by a chopping motion between the jaws instead of a sliding one. On such manner of wear Schlesinger [6] has based his subspecies of *Mastodon angustidens subtapiroideus*.

The original height of the outer cones of the first and second crests can not be determined exactly. Measured from the lower border of the enamel the heights are 53 mm., 61 mm., 68 mm., 68 mm., 45 mm. The third cone was originally but little higher than now. The inner cone of the fifth crest is 66 mm. high. The enamel of the trefoils is thick and moderately folded.

The roots of this tooth, except the outer anterior one, are shown on the inner side of the fragment of maxilla (pl. 4, fig. 1). The anterior branch of the inner front root rises to a height of 150 mm., the posterior branch to a height of 125 mm., and the front part of the great hinder root to a height of 125 mm.

[6] Denkschr. naturh. Staatsmus., vol. 1, 1921, p. 36 .

The lower right second molar (pl. 5, fig. 3) is so deeply worn that all of the dentinal areas are confluent and nearly all traces of trefoils are obliterated. The length was originally close to 125 mm. The width in front is 75 mm.; at the rear, 90 mm. There were three crests; also a talon, which was nearly destroyed by the pressure of the succeeding tooth and by the wear of mastication. The valleys are shown to have been wide to their bottoms. A large, well-worn tubercle is seen at the outer end of each valley and one at the inner end of the second valley. The tooth was apparently somewhat twisted outward during burial.

The lower right third molar presents a crown complete, except where worn by usage during life (pl. 2, fig. 1; pl. 5, fig. 3). The roots are mostly missing. The length of the crown is 223 mm.; the width at the first crest, 88 mm.; at the second, 92 mm.; at the third, 95 mm.; at the fourth, 92 mm.; at the fifth, 72 mm. All the crests are worn, the hindmost only slightly; none so much as to allow the dentine areas of the opposite ends of the crests to coalesce. The original heights of the crests can not, on account of the wear, be exactly determined. In the condition of wear, and measured on the slope from the lower border of enamel to the worn summit, the heights of the inner cones, from the first to the fifth, are as follows in millimeters: 51, 47, 58, 61, 55. The probable original elevations were greater by from 13 mm. in the second to 5 mm. in the fifth. The heights of the outer cones similarly measured are, in millimeters, 34, 39, 45, 53, 57. Trefoils are found on the outer halves of all the crests, although the lobes descending from the pretrite half of the fifth crest into the fourth valley are absent. The enamel of the trefoils and of the inner ellipses is little folded. There are no traces of trefoil-producing buttresses on the inner halves of the crests. Besides a fifth crest, there is a well-defined talon. A small amount of cement appears in many of the valleys, especially in the one between the last crest and the talon. A large patch of it is present at the outer end of the fourth valley.

The fifth crest requires further description. On the pretrite side it presents two cones, a large outer one and a small, thinner one next to the median cleft. No buttress appears on the front face of this half of the crest. On the rear face of the principal cone is a ridge, which may represent a buttress. On the posttrite side are two cones. The one on the lingual side resembles its homologue in the other crests. The other, the one next to the median cleft, is greatly enlarged, being 21 mm. wide in the right tooth, 24 mm. in the left. It is expanded forward, especially in the tooth of the left side, so as to join the pretrite buttress of the crest in front, partially blocking the fourth valley. In the tooth of the left side this cone sends

down on its front face three strong ridges, two of them crossing over to the buttress of the crest in front.

The talon is composed of three conules, the largest on the outer side, the smallest on the inner. One may satisfy himself that he finds the same elements as in the fifth crest.

The lower left hindmost molar is present and in fine condition, except that the roots are injured. Few differences between this and the one of the right side are observed. The length is 225 mm. At the first crest the width is 91 mm.; at the second, 95 mm.; at the third, 101 mm.; at the fourth, 93 mm.; at the fifth, 83 mm. Most of the great root supporting the front crest is preserved. Measured from the crown the height is 140 mm., and some part is missing. The width is 70 mm.

Of the upper tusks of the animal above described nothing is known. The lower teeth of this species show relationships of their possessor to Cope's *Dibelodon tropicus*,[7] a species based on H. von Meyer's *Mastodon humboldtii ?*,[8] found in Mexico and referred by Freudenberg to the Pleistocene. Von Meyer's plate was reproduced by Dr. W. Freudenberg in 1922.[9] The tooth from Aransas River appears not to belong to that species for these reasons: 1, The lower teeth of *Anancus tropicus* (Cope) appear to have possessed a well-defined cingulum; nothing of the kind appears in the Aransas tooth, except large tubercles in the ends of some of the valleys; also on the pretrite end of the fourth crest of the right lower tooth a row of small tubercles represents the cingulum. 2, The pretrite cones appear to have been less elevated. 3, The buttresses producing trefoils were evidently weaker than they are in the Aransas tooth, and the lobes of these are of a different form. 4, The fifth crest of *A. tropicus* is far simpler in structure than it is in *A. orarius*. 5, The talon of the former consists of a single conule, in *A. orarius* of three. This species is evidently in a higher stage of development than that named and described by Cope.

Cope in 1893[10] referred remains found in the Blanco beds to *Dibelodon tropicus*, first called by him *Mastodon successor;* but Osborn has restored the name last mentioned. These teeth appear to have trefoils on both halves of the two anterior crests.

In 1911[11] the writer characterized a large upper left hindmost molar of a mastodon from Fort Worth, Texas, and referred it to *Anancus gratus*. With a cast of this tooth at hand and a third molar of the type of *A. gratus* and the Aransas River upper third molar, the writer is inclined to refer the Fort Worth tooth (pl. 4,

[7] Proc. Amer. Philos. Soc., vol. 22, p. 7.
[8] Palaeontgr., vol. 17, 1867, p. 64, pl. 6.
[9] Geol. Palaeont. Abhandl., vol. 14, Heft. 3, p. 29.
[10] Vert. Palaeont. Llano Estac., p. 62, pls. 16, 17.
[11] Publ. 322 A, Carnegie Institution, Washington, p. 13.

fig. 2; pl. 6, fig. 1) to the new species. It differs from the type of *A. gratus* in being larger; in having the fourth crest more strongly developed, the inner cone of the fourth crest being 80 mm. high in place of the 62 mm. of *A. gratus;* in having a large talon approaching a crest; and in having large tubercles at the inner ends of the first and second valleys. The inner cone of the fourth crest has in front a buttress which nearly blocks the third valley, and another behind which joins closely the talon. This tooth differs from the upper last molar of *A. orarius* in some respects. The width does not diminish from front to the rear, the width at the first crest being 96 mm.; at the fourth, 97 mm. There is no well-defined fifth crest, but the talon may easily be regarded as a crest, and the buttress of the fourth crest joins it closely. No other structure represents a talon. The Fort Worth tooth is only slightly worn, but it is noted that trefoils begin to wear as in the teeth of the type of *A. orarius*. The differences observed may be due to individual variations or to those of closely related races.

Dr. W. Freudenberg[12] described and illustrated a fine tooth which he referred to *Mastodon tropicus*. This has remarkable resemblance to the upper molar from Fort Worth. The height of the cones appears to be too great for *M. tropicus*. Freudenberg identified his tooth as the lower left third molar. The slight obliquity of the crests appears to confirm this disposition of it. He wrote that there were incipient trefoils on the outer ends of the crests, but these hardly reveal themselves in the figure.

The upper third molar of the type of *Ananeus orarius* differs in various respects from that of *A. gratus*.[13] *A. orarius* is a larger and more rugged tooth, but that might be due to sex or some other condition. It has five crests and a talon; the third valley is blocked by butresses descending from the adjacent crests; there is a distinct tendency toward the formation of butresses on the posttrite ends of the crests; on the pretrite side there is, on the front half of the tooth at least, a distinct cingulum, and this, at the ends of the valleys, expands into large tubercles. In *Ananeus gratus* there are only four crests and a hinder talon; the third valley is wide open; no buttresses are developed on the posttrite ends of the crests; there are no traces of a cingulum on the sides of the tooth; and no tubercles are developed at the ends of the valleys.

Ananeus orarius differs in its lower hinder molar distinctly from that of *A. brazozius*.[14] The width is 0.45 of the length; the main cones are wedge shaped and the valleys are wide; the buttresses are simple and they do not block to a great height the valleys. In

[12] Geol. Palaeont. Abhandl., vol. 14, Heft. 3.
[13] Hay, Bull. Univ. Texas, No. 71, 1917, p. 18, pls. 3, 4.
[14] Hay, Pan. Amer. Geologist, vol. 29, 1923, p. 112, pl. 8, figs. 1, 2.

Anancus brazozius the width is only 0.40 of the length of the tooth; the main cones are high and columnar; the valleys are narrow; the buttresses are more complicated; and they block the valleys to a relatively great height.

The left lower third molar of the type specimen of this species was presented by Doctor Francis to the United States National Museum, and it now has the catalogue number 11,377.

ANANCUS DEFLOCCATUS, new species

Plate 7; plate 8, fig. 1

The second mastodon found near Sinton is represented by the left horizontal ramus and parts of its second and third molars, and by the hinder half of the lower right third molar. The individual was one of rather advanced age, as the hinder teeth are worn on all the crests.

Name from Latin *defloccatus*, a worn out, rusty old fellow (Ainsworth's Dictionary).

The horizontal ramus (pl. 8, fig. 1) is quite different from that of *Anancus orarius*, being much lower in front, 150 mm. or less at the front of the second molar, instead of 200 mm. as in *A. orarius*. Below this point the thickness is 105 mm. At the rear of the third molar the height is 130 mm., the width 180 mm. The symphyseal articulation is 135 mm. long and 96 mm. high. The jaw seems not to have ended in a beak as in many mastodons. There are three mental foramina, all opening near the alveolar border. A small one is situated below the hinder border of the front root of the second molar, another just below the front border, and a third about 35 mm. further forward. The second and the third have a diameter of about 5 mm.

In the jaw are remains of the second and the third molars. Of the second there remain the anterior root and the hinder root, capped by a part of the last crest worn down so that only the dentine is seen and a fragment of the enamel on the inner border. More of the tooth was present but was lost in collecting. The front root is about 50 mm. wide and 40 mm. front to rear. It seems a large remnant for a tooth so nearly worn out. From the front of this root to the rear of the tooth is 110 mm. The width of the crown in front may have been more than 70 mm.; at the rear, nearly 100 mm. The fore-and-aft width of the last crest was at least 36 mm. There could therefore have been only three crests. The structure of these can be judged only from their condition in the hindmost molar. Unfortunately the third molar is much injured, a large section of the middle of its length being absent (pl. 7). The crown was 230 mm. long, and it consisted of five crests and a hinder talon. Width of

the crown at the first crest, 100 mm.; at the third, 101 mm.; at the fourth, 93 mm.; at the fifth, 85 mm.

The bases of the anterior crest and a part of the second are present. On the outer side they are worn down quite to the base of the enamel; on the inner side the enamel rises not more than 33 mm. The inner end of the first valley is present and exposes the remains of a large tubercle which blocked it more or less. A considerable part of the enamel of the third crest remains. The fourth shows on the outer end a trefoil whose anterior lobe is large and meets the hinder lobe of the trefoil of the third crest. On the front face of the inner cone is a buttress which was worn down so as to present a circle of dentine. This, with some tubercles, blocked the third valley. No buttress is found on the rear face of the inner end of this fourth crest; but at its base, as in the third valley, close to the midline, are two tubercles. A small buttress is present on the front face of the outer half of the fifth crest and aids in blocking the valley on that side. The hinder face is expanded backward, but no distinct buttress is formed. On the front face of the inner end of this fifth crest is a buttress which on further wear would have produced a lobe of a trefoil, imperfect only because no corresponding buttress is developed on the hinder face. The talon is rather small and consists of a large conule and a row of three smaller ones on the posttrite side of it.

On the outer side of the base of the crown is a distinct cingulum, composed at the ends of the crests of a row of small tubercles, while opposite the outer ends of each of the valleys is a large, rounded tubercle. Similar tubercles are located at the inner ends of all the valleys. The enamel is nearly everywhere more or less rough and wrinkled. The valley between the fifth crest and the talon is nearly filled by a mass of cement. A much smaller amount is seen in the fourth valley at the midline of the tooth.

This lower third molar must be compared with that of *A. orarius*. However much they differ, however closely they agree, the jaws testify that two species are present. It is evident that the molar of *A. defloccatus* had crests less elevated than those of *A. orarius*. Also there is an evident tendency to the production of trefoils on the posttrite side of the crests. The presence of a distinct cingulum on the pretrite side of the crown and of the large, knoblike prominences at the ends of the valleys distingish this species from *A. orarius*.

Doctor Francis presented to the United States National Museum the lower right third molar of the type specimen of *Anancus defloccatus*, and to this has been assigned the number 11,378.

In the Francis collection from near Sinton is a small tooth of a mastodon which is possibly a first milk molar, but which is taken

to be a third premolar (pl. 3, figs. 2, 3). To which of the two species of mastodons found by Doctor Francis it belonged, if either, it is impossible to determine. The tooth had not yet come into action. It appears to be an upper tooth, but whether upper or lower, it belonged to the left side. The length of the crown is 31 mm.; the greatest width, that at the second crest, is 30 mm.; the heighth, 22 mm. Seen from above the crown is approximately triangular, with the angles rounded. The anterior crest consists of a pretrite cone without subsidiary conules. The posttrite half consists of a principal cone against whose hinder face is a conule, the summit of which is free. The conule forms a sort of buttress. The hinder crest presents, in the pretrite half, a main cone between which and the medium cleft is a subsidiary conule. The front face of the main cone shows a rather prominent buttresslike ridge which partly blocks the valley. The rear face presents another ridge not so large but more distinctly marked off from the main cone. These buttresses appear to presage the development of a trefoil on the second crest. The posttrite half of the second crest consists of a large principal cone and a row of three conules between it and the midline. The main cone is furnished on its front face with a distinct ridge descending to the valley, and a similar one on the rear face.

Above the base of the crown in front is a prominent beaded cingulum, and this passes backward on the pretrite side to the mouth of the valley. It is not present on the posttrite side. At the rear of the crown is a cingulum of a row of about 20 small tubercles of varying size. At a little higher level and between the cingulum and the base of the second crest is a row of about 8 conules which appear to represent a rear talon. The surface of the enamel is everywhere wrinkled, and there is shown a tendency to the formation of ridges and sharp pustules.

EXPLANATION OF PLATES

Plate 1

Fig. 1. *Glyptodon petaliferus.* Portion of carapace from above the sacrum. ×1.

2. *Neochoerus pinckneyi.* Part of lower jaw, left side. ×1. *co. pr.* Coronoid process. *m. for.* Mental foramen.

Plate 2

Fig. 1. *Ananeus orarius.* Type. Lower right third molar, showing grinding surface. ×⅔.

2. *Chlamytherium septentrionale.* Part of right side of lower jaw, showing four hinder teeth. ×1.

3. *Glyptodon petaliferus.* Part of right side of lower jaw, showing seventh and eighth teeth. ×1.

Plate 3

Fig. 1. *Ananeus orarius.* Upper right third molar, showing grinding surface. Type. ×⅔.

2, 3. *Ananeus*, species indeterminable.

2. Supposed upper right third premolar. Grinding face. ×1.

3. Same tooth seen from inner side. ×1.

Plate 4

Fig. 1. *Ananeus orarius.* Part of maxilla with third molar. Seen from inner side and showing crown and roots of the tooth. Type. ×0.43.

2. *Ananeus orarius.* Upper left third molar. Fort Worth specimen. Showing inner face. ×0.56.

Plate 5

Figs. 1–3. *Ananeus orarius.*

1. Right maxilla with third molar. Seen from right side. Type. ×0.3±.

2. Lower face of symphysis showing keels, included furrow, foramina, and possible sockets for vestigial lower tusks. Lingual groove above. ×0.6±.

3. Front of lower jaw with the second and third molars. Seen from right side. ×0.28±.

Plate 6

Fig. 1. *Ananeus orarius.* Upper left third molar. Fort Worth specimen. Showing grinding surface. ×⅔.

2. *Neochoerus pinckneyi.* Left side of lower jaw seen from within. Shows front tooth, parts of sockets of others, and the smooth surface forming a part of the socket for the left incisor. ×1.

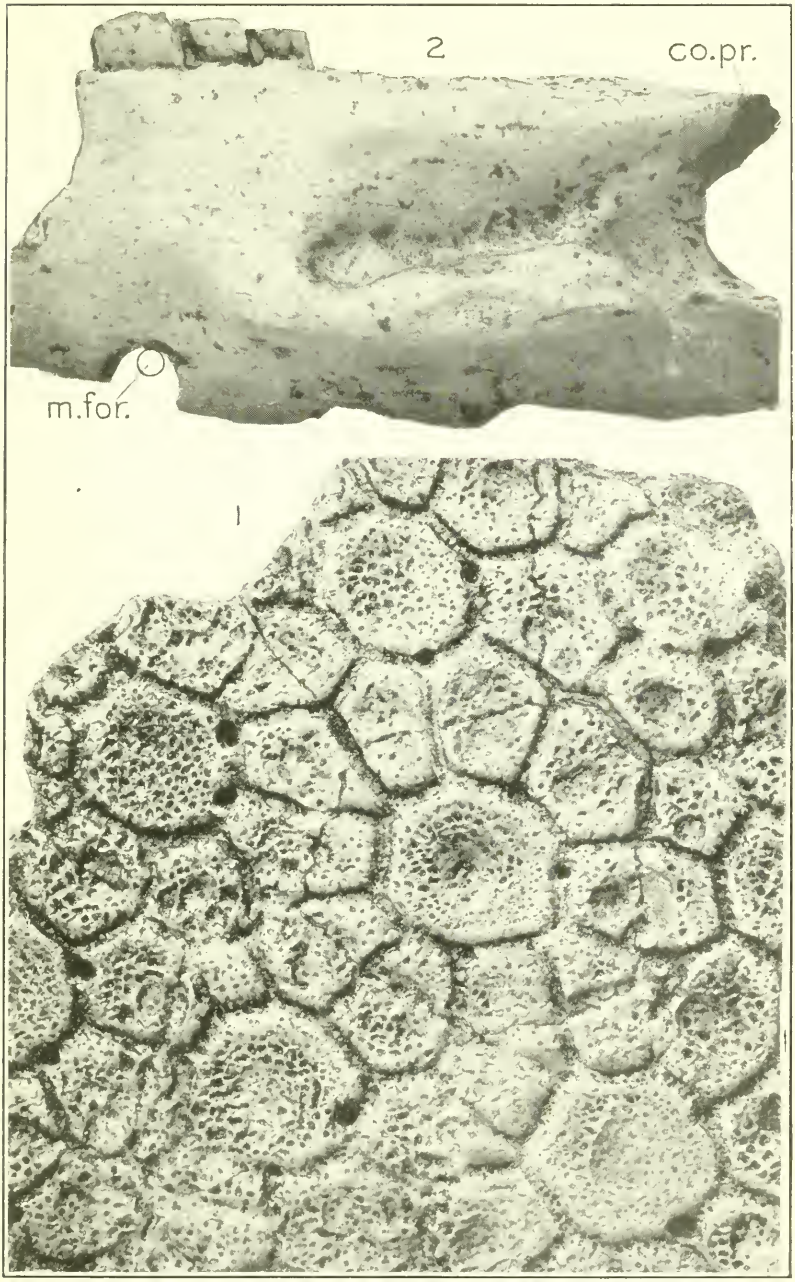
PLATE 7

FIG. 1. *Anancus defloccatus.* Lower left third molar, showing the injured grinding face. Type. ×⅔.

PLATE 8

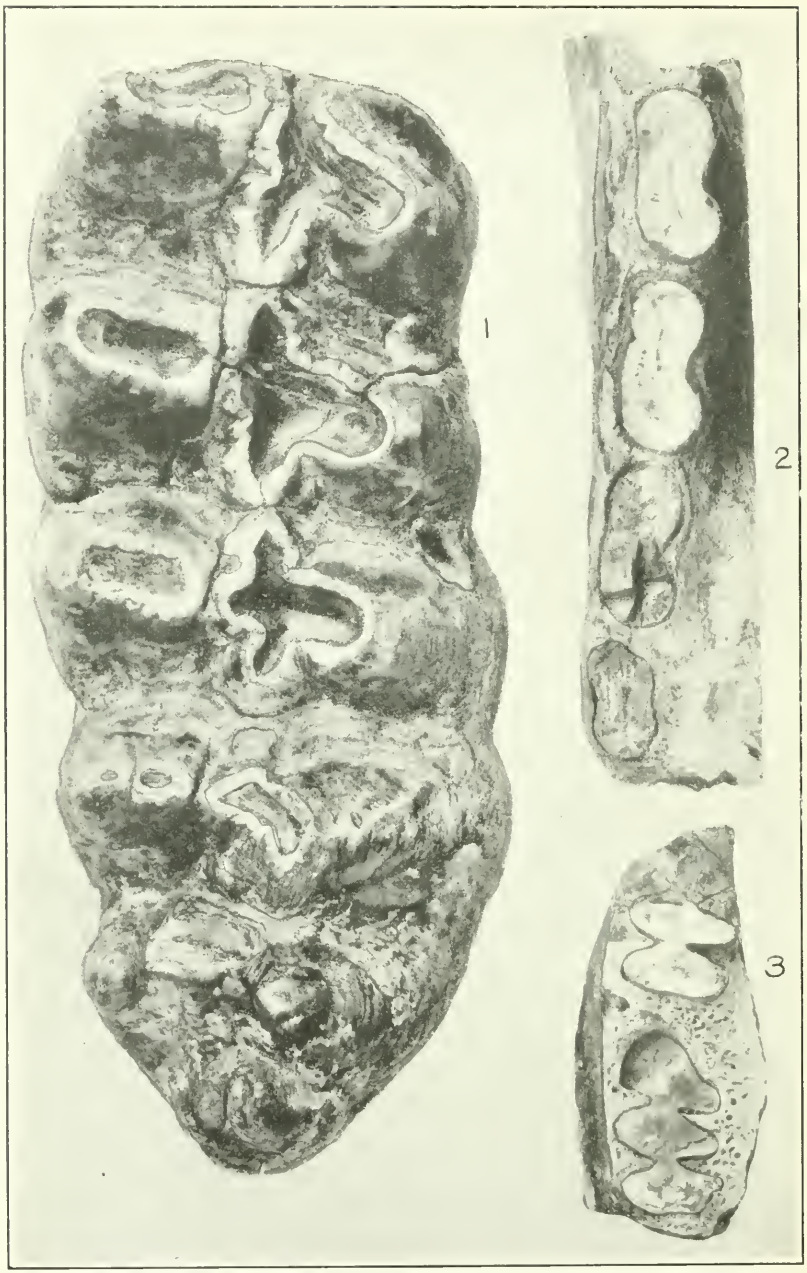
FIG. 1. *Anancus defloccatus.* Horizontal ramus showing its inner face, the symphysis, and the second and third molars. Type. ×0.3±.

2. *Neochoerus pinckneyi.* Left side of lower jaw seen from above. Shows the front tooth, the insertion of the masseter muscle, and the reduced coronoid process. ×1.



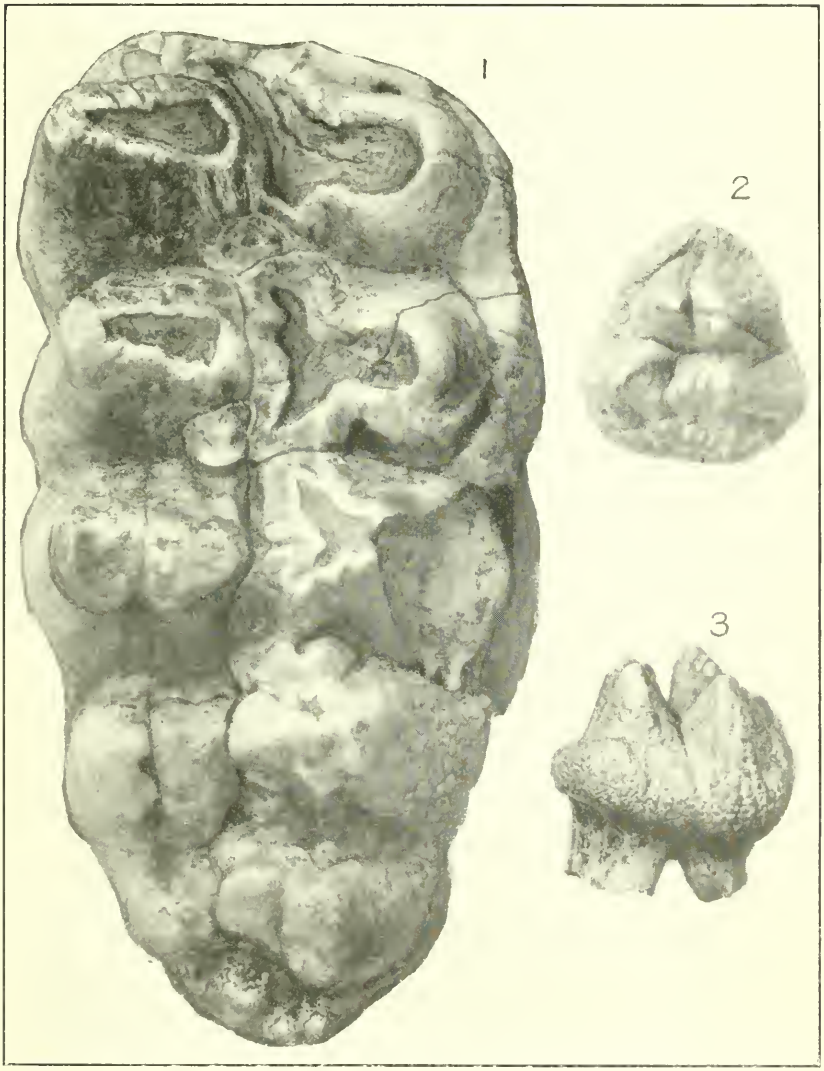
1. GLYPTODON PETALIFERUS. 2. NEOCHOERUS PINCKNEYI

FOR EXPLANATION OF PLATE SEE PAGE 17



1. ANANCUS ORARIUS. 2. CHLAMYTHERIUM SEPTENTRIONALE. 3. GLYPTODON PETALIFERUS

FOR EXPLANATION OF PLATE SEE PAGE 17



TEETH OF ANANCUS

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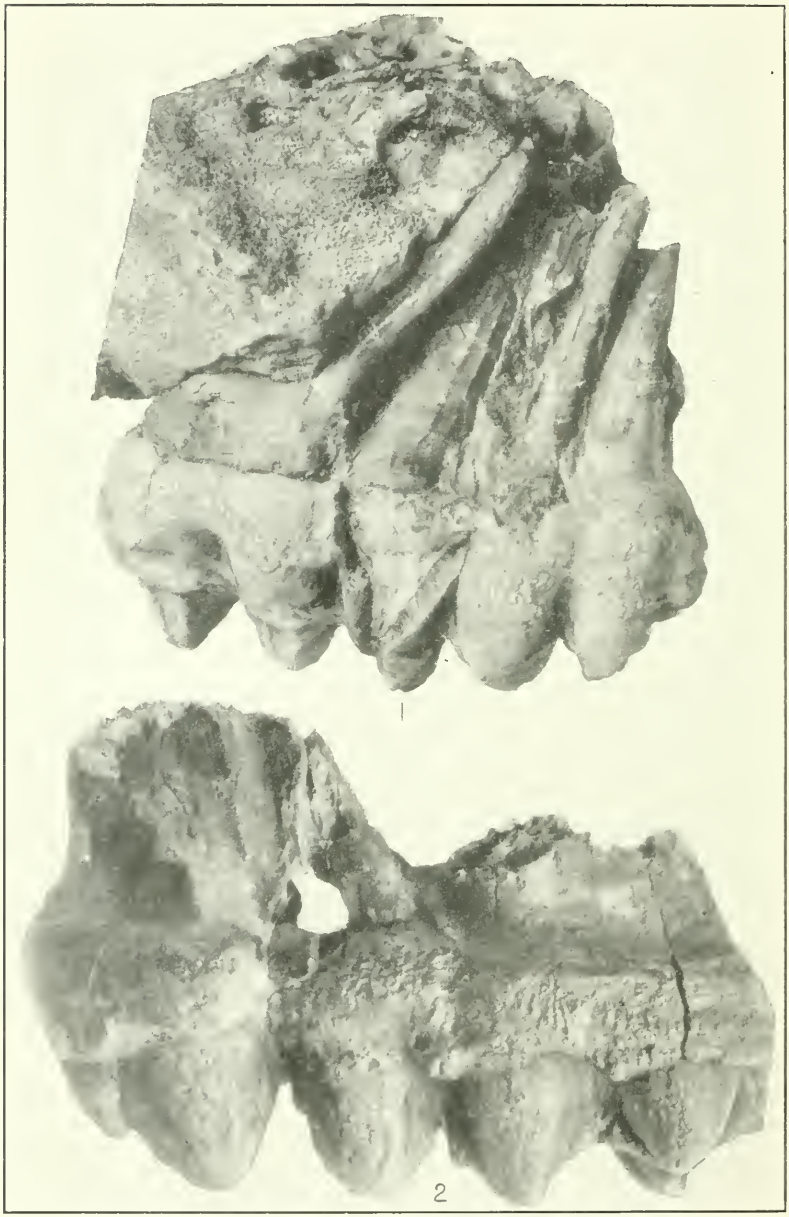

TEETH OF ANANCUS ORARIUS

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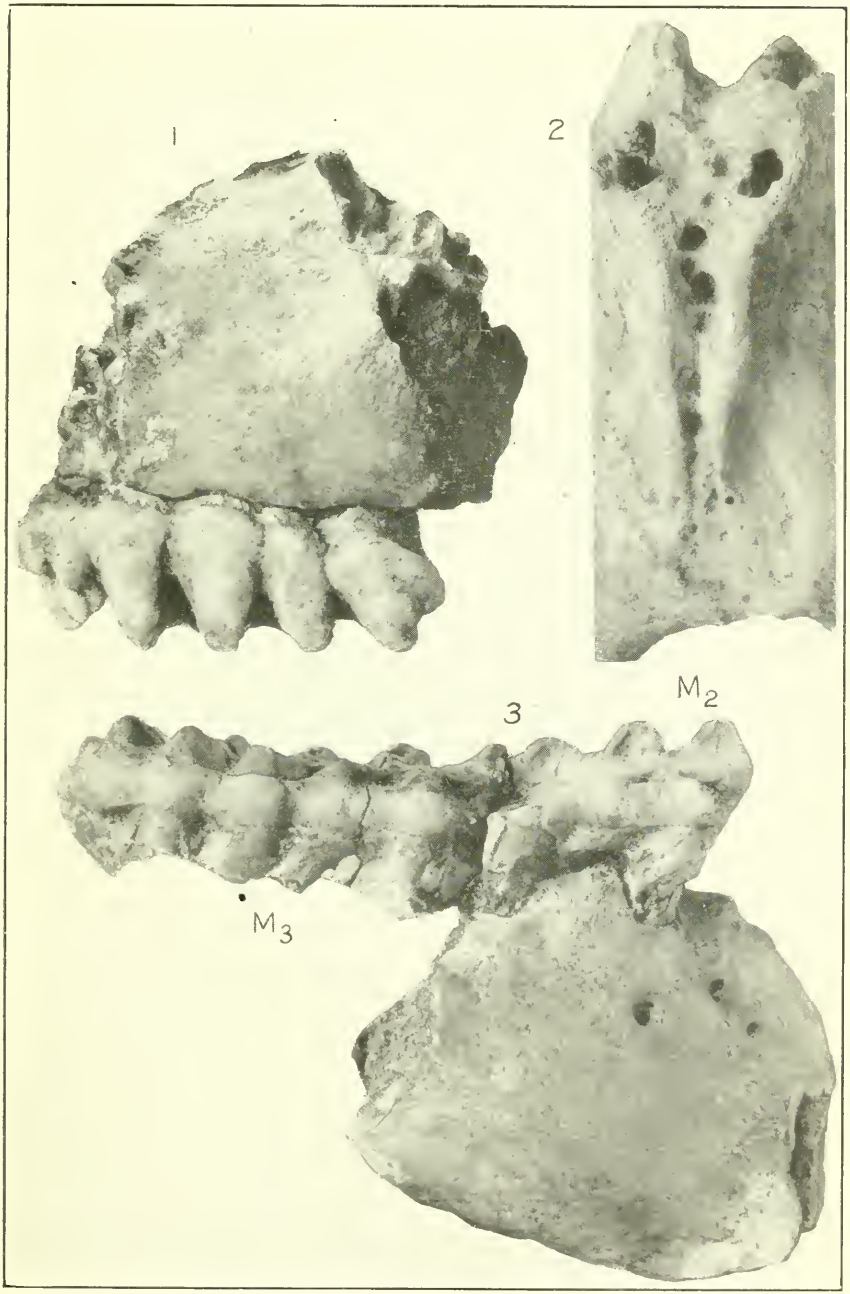

TEETH AND JAWS OF ANANCUS ORARIUS

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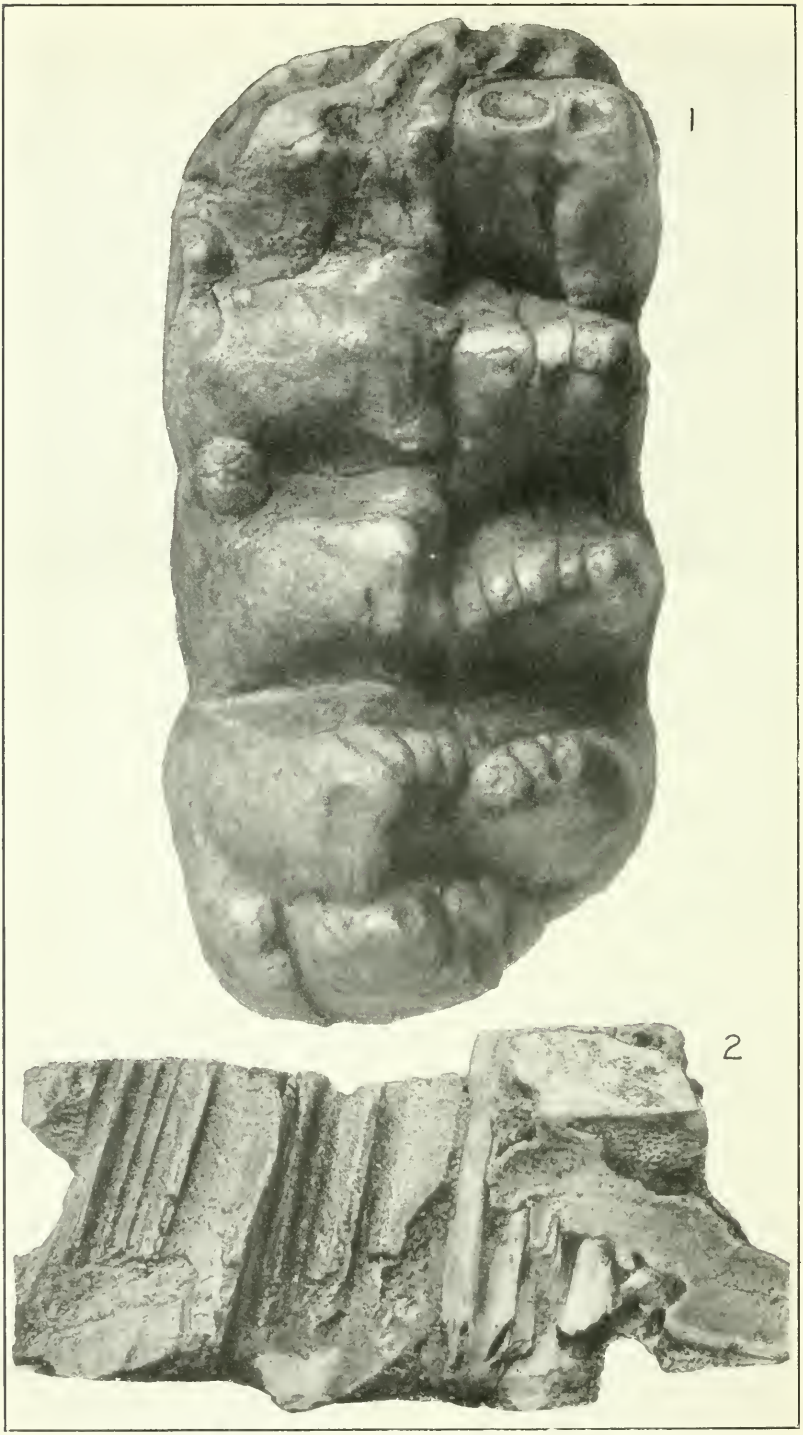

1. ANANCUS ORARIUS. 2. NEOCHOERUS PINCKNEYI

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TOOTH OF ANANCUS DEFLOCCATUS

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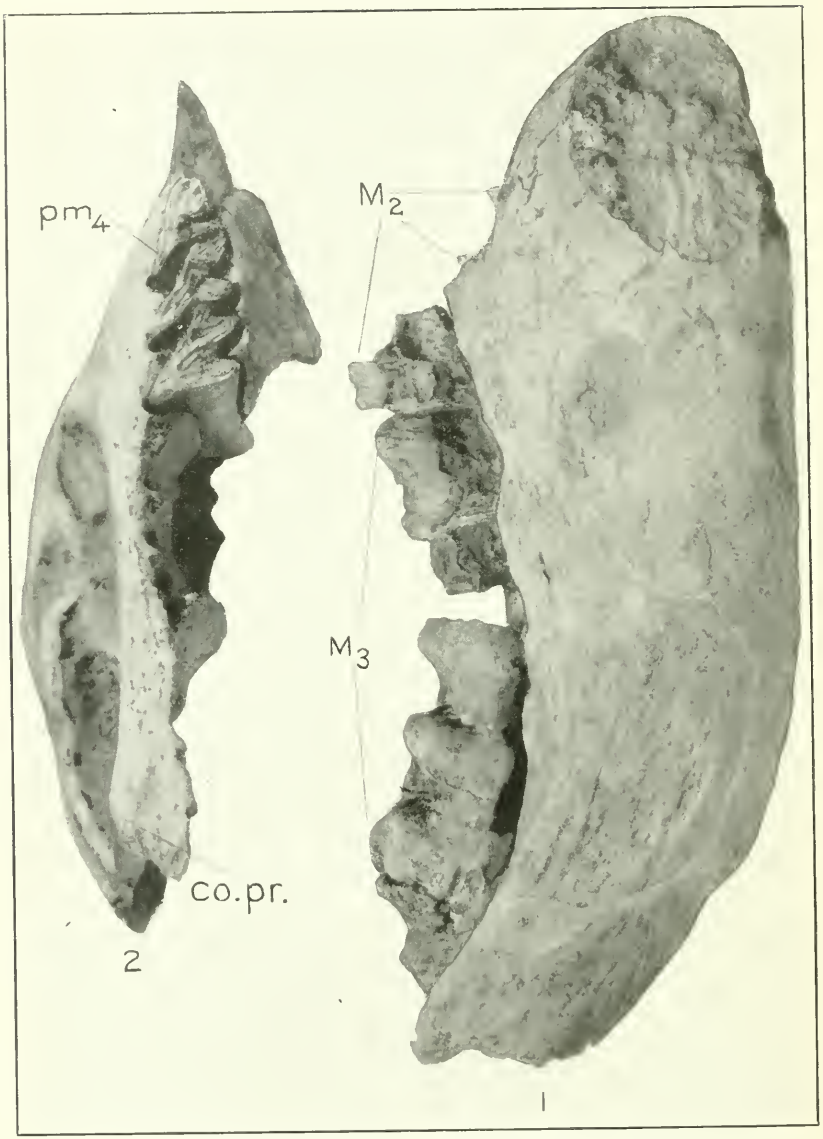

1 ANANCUS DEFLOCCATUS. 2. NEOCHOERUS PINCKNEYI

FOR EXPLANATION OF PLATE SEE PAGE 18

AMPHIPODS OF THE FAMILY BATEIDAE IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM

By Clarence R. Shoemaker

Assistant Curator, Division of Marine Invertebrates, United States National Museum

After Fritz Müller described the genus *Batea* from the coast of Brazil in 1865, it was not again heard of until 1903 when Samuel J. Holmes observed it among material dredged by the United States Fisheries steamer *Fish Hawk* in 1900 near Woods Hole, Massachusetts. In 1901 Holmes also collected specimens at Woods Hole. During 1904 and 1905 the *Fish Hawk* took specimens from many localities about Vineyard Sound. Dr. C. J. Fish has presented to the United States National Museum specimens which he collected at Woods Hole in 1922. It thus appears that the genus is fairly common in the vicinity of Woods Hole. In 1918 three specimens of *B. catharinensis* were taken at Barbados by the Barbados-Antigua Expedition of the State University of Iowa.

Recently, while sorting the unidentified Amphipoda in the collection of the United States National Museum, I noted the occurrence of this genus at several new and widely separated localities. During 1889 and 1891 the *Fish Hawk* dredged specimens from several localities along the coast of South Carolina, and in 1891 she obtained specimens from Tangier Sound in Chesapeake Bay. In the course of the Biological Survey at Chesapeake Bay from 1915 to 1921 the *Fish Hawk* found this genus to be common in almost every part of the bay. Florida has to the present time yielded but one specimen of *B. catharinensis* and this without date or collector given.

The United States Fisheries steamer *Albatross* on her 1911 cruise, while in the Gulf of California, obtained the first representatives of the genus *Batea* from the west coast of America. In 1912 the Venice Marine Biological Station of the University of Southern California procured specimens from the entrance to Catalina Harbor, Santa Catalina Island. P. S. Barnhart of the Scripps Institution in 1915 obtained specimens off La Jolla, southern California, and Dr. Waldo L. Schmitt, while investigating the life history of

No. 2626.—Proceedings U. S. National Museum, Vol. 68, Art. 25.
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the western spiny lobster in 1918, procured additional specimens from the same locality.

Batea is apparently a littoral genus and occurs at depths from 2 to 45 fathoms. This genus will probably be found to inhabit the entire tropical and temperate coasts of the Western Hemisphere. Comparatively few amphipods have been collected in these regions, but in almost every instance where systematic investigation has been carried on, this supposedly rare genus has been brought to light.

The *Albatross* in 1885 dredged from two localities off the west coast of Florida specimens of the family Bateidae which, on account of their prominent dorsal teeth, I have put into a new genus, *Carinobatea.* While at the Virgin Islands during the summer of 1915 I collected additional specimens of this new genus at several localities about the Island of St. Thomas.

To the present time members of this family have appeared in the waters of the Western Hemisphere only.

Family BATEIDAE Stebbing

The family as characterized by Stebbing in 1906 in "Das Tierreich" Amphipoda (p. 355) is as follows: Head strongly rostrate. Side-plate 1 rudimentary. Antenna 1 without accessory flagellum. Mandible with palp. Gnathopod 1 degraded, without hand. Telson cleft.

Genus BATEA

1865. *Batea* FRITZ MÜLLER, Ann Mag. Nat. Hist., ser. 3, vol. 15, p. 276.

Body not dentate. Side-plate 4 rather large and deeply excavate behind. Antenna 1 little shorter than antenna 2. Maxillipeds, outer plates not quite reaching apex of second joint of palp, and fringed with spine-teeth on inner margin. Gnathopod 1 degraded, ending with a feeble linear second joint, which is slightly longer in female than in male. Gnathopod 2 subchelate. Peraeopods 3–5, second joint expanded. Uropod 2 shorter than uropod 1 or 3; uropod 3, peduncle short, rami subfoliaceous. Telson rather short, deeply cleft.

BATEA CATHARINENSIS Müller

(Figures 1–4)

1865. *Batea catharinensis* MÜLLER, Ann. Mag. Nat. Hist., ser. 3, vol. 15, p. 276, pl. 10.

1903. *Batea secunda* HOLMES, The Amer. Naturalist, vol. 37, no. 436, p. 284.

1905. *Batea secunda* RATHBUN, Occasional Papers of the Bost. Soc. Nat. Hist., vol. 7. Fauna of New England, no. 5, p. 66.

1905. *Batea secunda* HOLMES, Bulletin of the Bureau of Fisheries for 1904, vol. 24, p. 499, text figure.

1906. *Batea catharinensis+B. secunda* STEBBING, Amphipoda, I, Gammaridea. Das Tierreich, vol. 21, pp. 355, 356; 729.

1913. *Batea secunda* SUMNER, OSBURN, and COLE, Bulletin of the Bureau of Fisheries for 1911, vol. 31, pt. 2, p. 651.

1918. *Batea secunda* KUNKEL, Conn. State Geological and Natural History Survey, Bulletin No. 26, p. 89, fig. 18.

1921. *Batea catharinensis* SHOEMAKER, Univ. of Iowa Studies. Studies in Nat. Hist., vol. 9, no. 5, p. 100.

Head; rostrum reaching to about two-thirds the length of the first joint of antenna 1, slightly curved downward, spear-shaped, sharply pointed; lateral angle rather blunt; lower anterior angle subquadrate. Eyes large, dark, reniform, larger in male than in female. Antenna 1 and 2 longer in male than in female. Antenna 1, second joint narrower and a little shorter than first, third joint narrower than second and about one-third as long, under edge of first and second joints in male bearing several fascicles of short setae, flagellum many-jointed, setae of alternate joints directed forward and backward in male and forward and downward in female, alternate joints in female bearing also sensory filaments. Antenna 2, fifth joint narrower but very little shorter than fourth, upper edge of fourth and fifth joints in male bearing several fascicles of short setae, lower edge of fourth and fifth joints in female bearing several fascicles of long setae, flagellum many-jointed, alternate joints in female bearing two long and one short seta on under side. Upper lip rounded and bearing a fringe of fine setules on rounded apex. Mandible, cutting edge narrow, sharply toothed throughout, accessory plate also toothed, five serrated spine teeth in spine-row of left mandible and four in that of right, molar strong, prominent, bordered by a single plumose setule and a row of fine teeth on upper edge, a strong protuberance between molar and base of palp, palp with second joint stouter but very little longer than third, both second and third joints provided on their front margins with numerous bristles. Maxilla 1, outer plate with 10 or 11 toothed spines, inner with four or five plumose setae, palp with first joint about one-half the length of second, which is provided distally with a few short, blunt spine-teeth and a few short setae. Maxilla 2, outer plate slightly wider and longer than inner, armed distally with many long curved bristles, inner plate armed distally with many bristles and two plumose setae. Maxilliped, outer plate reaching about three-fourths the distance along the second joint of palp, somewhat truncated distally and provided on the truncated end with a few plumose setae, inner edge provided with about five odontoid spines and a few short, curved, blunt bristles, inner plate provided on its truncated end with three short, stout odontoid spines, and on the end and inner edge with plumose setae, palp with third joint provided with a stout, curved claw. Lower lip, outer lobes large and distally rounded, inner lobes small, mandibular processes well developed.

Gnathopod 1 very slender, curved backward, not reaching end of second joint of gnathopod 2, a little longer and stouter in female than in male, second joint in male with a few setae along the front

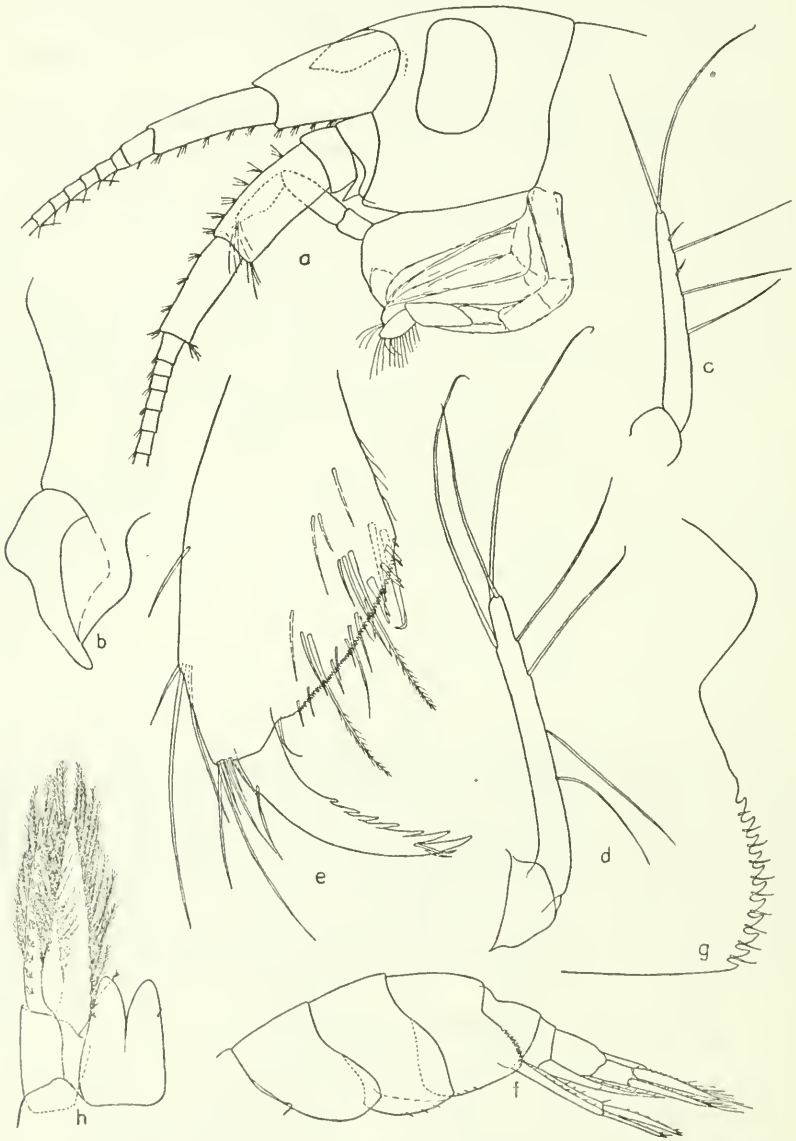

FIG. 1.—BATEA CATHARINENSIS MÜLLER, MALE, WOODS HOLE, MASS. *a*, HEAD AND ANTENNAE; *b*, UPPER LIP AND EPISTOME; *c* AND *d*, FIRST GNATHOPODS OF DIFFERENT INDIVIDUALS; *e*, GNATHOPOD 2, SHOWING TEETH OF PALM; *f*, ABDOMEN AND APPENDAGES; *g*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3; *h*, UROPOD 3 AND TELSON

margin, two long, curved setae at distal end and usually one on hind margin near distal end, in the female the setae on front margin more numerous, a group of curved setae at distal end and a long curved

seta on hind margin near apex. Gnathopod 2, second joint equal in length to fifth and sixth combined, third and fourth joints short, fifth joint greatly widened distally, the hind margin produced into

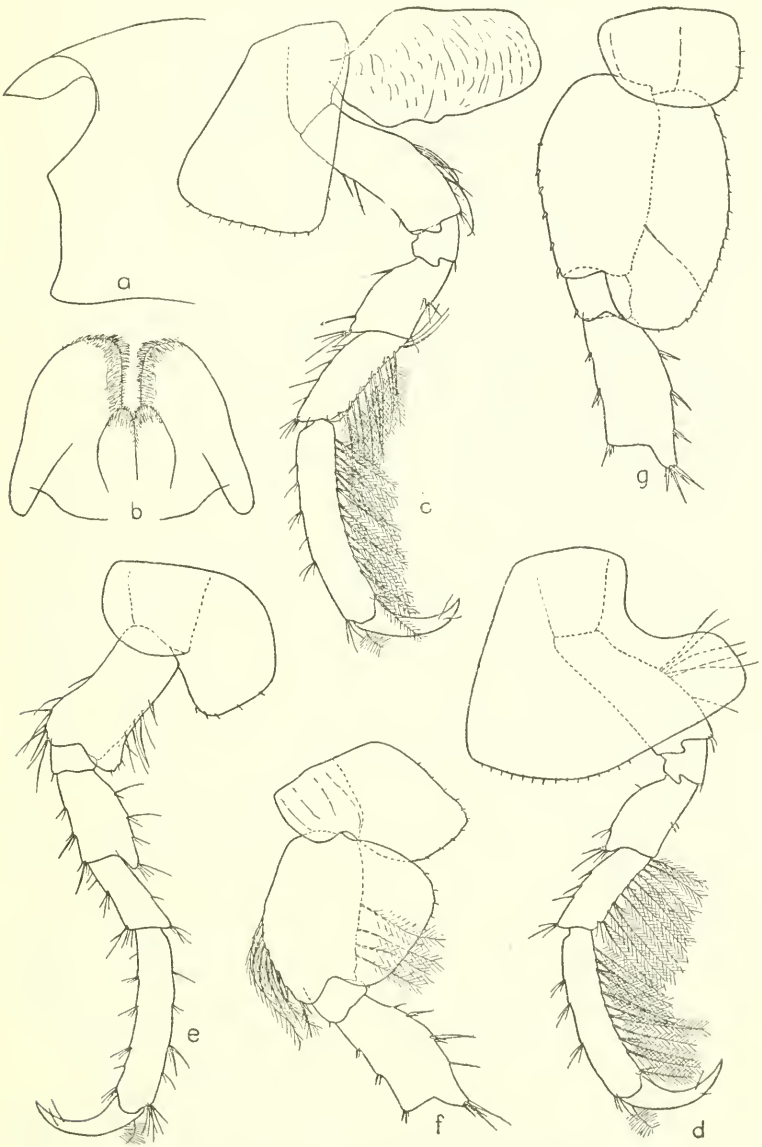

FIG. 2.—BATEA CATHARINENSIS MÜLLER, MALE, WOODS HOLE, MASS. *a*, HEAD; *b*, LOWER LIP; *c*, PERAEOPOD 1; *d*, PERAEOPOD 2; *e*, PERAEOPOD 3; *f*, PERAEOPOD 4; *g*, PERAEOPOD 5

a deep triangular lobe provided on front margin with many forward-pointing bristles, sixth joint one-fourth longer than fifth and nearly as wide, palm a little longer than hind margin, finely toothed

throughout, very oblique, and defined by a few double-pointed spines, finger equaling palm, curved, and bearing several forward-pointing teeth. Peraeopods 1 and 2, fifth and sixth joints in male provided on their hind margins with a row of long plumose setae. Peraeopod

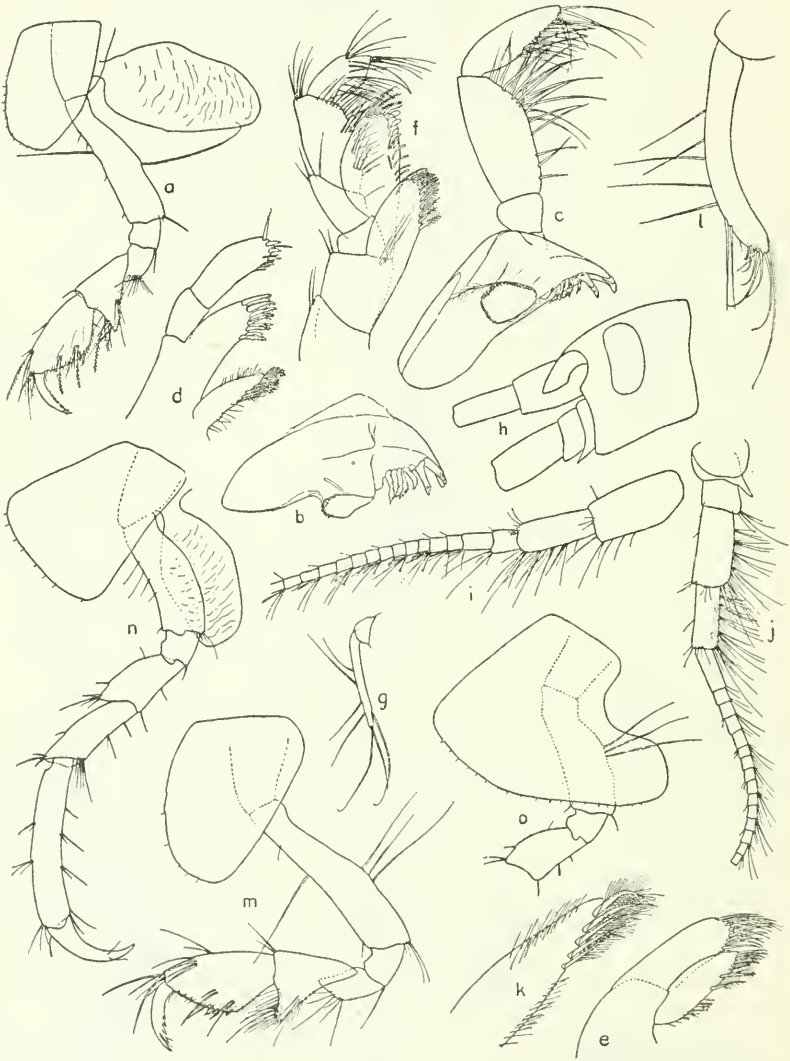

FIG. 3.—BATEA CATHARINENSIS MÜLLER, WOODS HOLE, MASS. MALE.—*a*, GNATHOPOD 2; *b* AND *c*, LEFT MANDIBLE; *d*, MAXILLA 1; *e*, MAXILLA 2; *f*, MAXILLIPED; *g*, GNATHOPOD 1. FEMALE.—*h*, HEAD; *i*, ANTENNA 1; *j*, ANTENNA 2; *k*, INNER PLATE OF MAXILLA 1; *l*, GNATHOPOD 1; *m*, GNATHOPOD 2; *n*, PERAEOPOD 1; *o*, PERAEOPOD 2

3, distal end of second joint a little expanded in front and slightly lobed behind, remaining joints as in peraeopods 1 and 2. Peraeopod 4, second joint greatly expanded, widest through proximal portion, lower half of front margin provided with long plumose setae, and a

few long plumose setae arising from the lower half of the hind margin of the muscular portion of the joint, remaining joints as in the preceding peraeopods. Peraeopod 5 longest, second joint

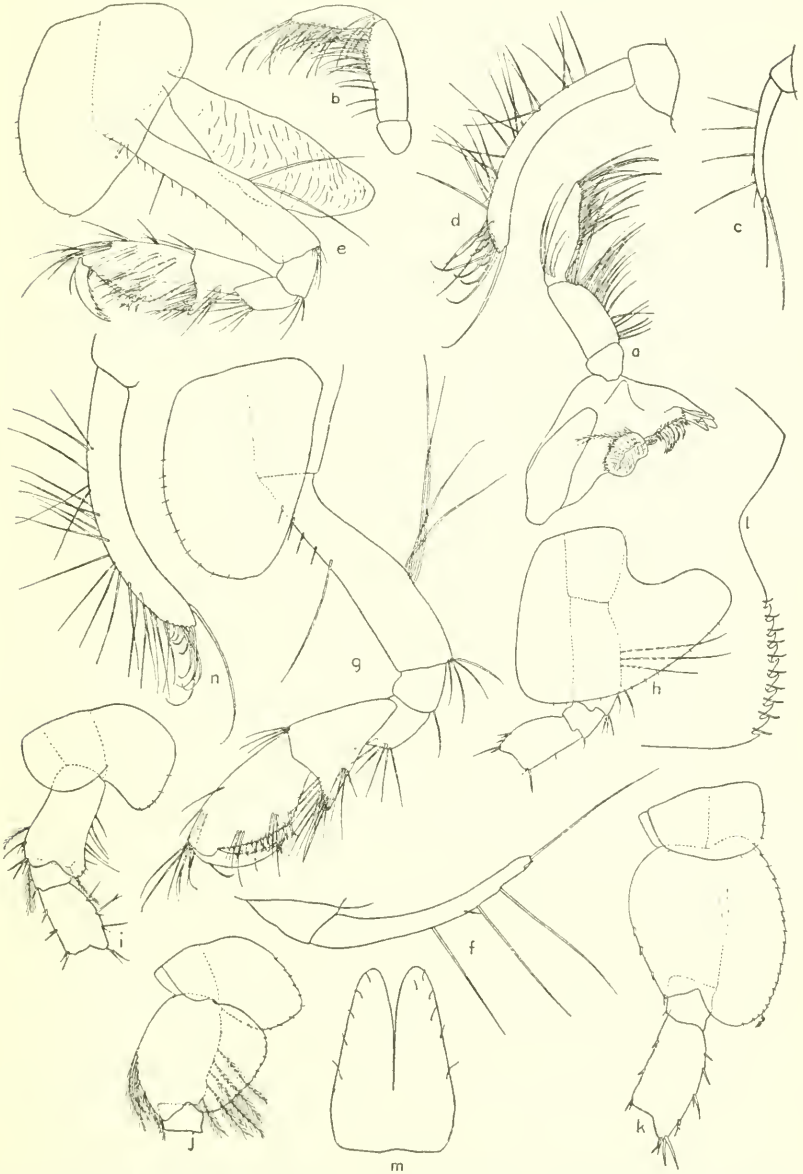

FIG. 4.—BATEA CATHARINENSIS MÜLLER, CHESAPEAKE BAY.—*a*, LEFT MANDIBLE, FEMALE; *b*, PALP OF LEFT MANDIBLE, FEMALE; *c*, GNATHOPOD 1, MALE; *d*, GNATHOPOD 1, FEMALE; *e*, GNATHOPOD 2, FEMALE. INSIDE MOUTH OF MAY RIVER, SOUTH CAROLINA.—*f*, GNATHOPOD 1, MALE; *g*, GNATHOPOD 2, MALE; *h*, PERAEOPOD 2, MALE; *i*, PERAEOPOD 3, MALE; *j*, PERAEOPOD 4, MALE; *k*, PERAEOPOD 5, MALE; *l*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3, MALE; *m*, TELSON, MALE. MOUTH OF BULL'S CREEK, NEAR COOPER RIVER, SOUTH CAROLINA.—*n*, GNATHOPOD 1, FEMALE

greatly expanded, widest through the proximal third, distal portion of hind margin produced into a broad, downward-projecting lobe reaching below the third joint, remaining joints as in the preceding peraeopods. Side-plate 2 about as deep as its segment, front margin convex, forming an almost even curve with the lower margin, lower anterior angle scarcely discernible, hind border in male slightly convex, in female nearly straight. Side-plate 3 expanded below, sides and lower margin nearly straight. Side-plate 4 a little deeper than its segment, very broad and deeply excavate on the upper hind margin. Side-plates 5 and 6 shallow with hind lobe much deeper than front. Side-plate 7 shallow with lower margin evenly convex. Abdominal segment 3, lower hind margin evenly convex, lower half armed with a row of fine upward-pointing teeth at the base of each of which is a setule. Uropod 1 reaching farther back than 2 but not so far as 3, peduncle a little longer than rami, outer ramus slightly shorter than inner. Uropod 2, peduncle very little longer than inner ramus, outer ramus two-thirds the length of inner. Uropod 3, peduncle short, rami lamelliform and spear shaped, provided on their outer and inner edges with many short spines and long plumose setae. Telson cleft beyond the middle, apices blunt and rounded, inner edges convex.

Adult specimens measure from 5 to 8 mm. in length. I have examined specimens of this species from Woods Hole, Mass., Chesapeake Bay, coast of South Carolina, west coast of Florida, and Barbados and I can not detect any specific differences. *Batea secunda* Holmes is undoubtedly identical with *Batea catharinensis* Müller. The coxal joint of the first gnathopod, one of the characters which Holmes used for fixing his species, is extremely rudimentary and imperfectly formed so that it is very difficult to assign any definite form or size to it.

There are in the collection of the United States National Museum the following specimens: 20 specimens collected at Woods Hole, Mass., by S. J. Holmes, July 18, 1901; 28 specimens collected at Woods Hole, Mass., by Dr. C. J. Fish, June 10, 1922; 3 specimens collected in Tangier Sound, Chesapeake Bay, by the steamer *Fish Hawk*, June 4, 1891; 100 specimens collected one mile inside of May River, South Carolina, by the steamer *Fish Hawk*, January 17, 1891; 200 specimens collected at west end of Skull Creek, South Carolina, by the steamer *Fish Hawk*, January, 1891; 1 specimen collected at the mouth of Bull's Creek, near Cooper River, South Carolina, by the steamer *Fish Hawk*, January 18, 1889; 1 specimen from Tampa Bay, Florida, collector and date unknown; several hundreds of specimens from Chesapeake Bay, collected by the steamer *Fish Hawk* during the years 1915 to 1921.

Three specimens collected by the Barbados-Antigua Expedition of 1918 at Pelican Island, Barbados, May 13, 1918, are in the collection of the University of Iowa.

BATEA RECTANGULATA Shoemaker

(Figures 5–7)

1925. *Batea rectangulata* SHOEMAKER, Bull. Amer. Mus. Nat. Hist., vol. 52, art. 2, p. 31, figs. 7–9.

Female.—Head with rostrum strongly curved downward and acutely pointed. Mandibles with five spine-teeth on left and four on right; palp, third joint about two-thirds as long as second, and provided on distal half of front margin with many long, curved, minutely-plumosed setae, and near the proximal end of back margin with two long curved, minutely-plumosed setae; one of the distal spines of the third joint much enlarged, making it appear quite dactyl-like; second joint of palp with stout setae on distal half of front margin. Lower lip without inner lobes, or at best only a mere suggestion of them. Maxilla 1, inner plate with seven plumose setae, below which are several setules, outer plate provided with 10 or 11 very stout, curved, toothed spine-teeth, palp with first joint about two-thirds the length of second, second joint evenly rounded distally and provided with many short spines. Maxilla 2 with both plates evenly rounded distally, inner plate furnished with two plumose setae and many long sharp spines, outer plate furnished distally with many long, sharp, curved spines. Maxillipeds, inner plate reaching to about the middle of the first joint of the palp, armed on truncated end and along inner margin with long plumose setae, one sharp spine-tooth among the setae on the truncated end could be discerned, but if others were present they were completely hidden by the mass of surrounding plumose setae, outer plate reaching beyond the second joint of palp and provided on the inner edge with 12 tooth-like spines, no plumose setae at distal end of this plate, outer edge provided with a row of fine setules. The three joints of the palp all of equal length, dactyl stout with downward-pointing tip. Gnathopod 1 with the terminal spines of second joint much as in *B. catharinensis*, front margin with five or six long setae, and two long curved setae near the distal end of hind margin. Gnathopod 2 proportionately longer and more slender than in *B. catharinensis*, second joint very slender and nearly as long as the third, fourth, fifth, and sixth joints combined, fifth joint slender and slightly longer than sixth, sixth joint slender, palm oblique, about two-thirds the length of hind margin and minutely serrated throughout its length, dactyl slightly curved and bearing four forward-pointing teeth and several setules on inner margin. Peraeo-

pod 1, fifth and sixth joints missing, second joint with a row of short, slender spines on front margin and two groups of long bristles near the distal end of hind margin. Peraeopod 2, fifth and

FIG. 5.—BATEA RECTANGULATA SHOEMAKER, SAN FRANCISQUITO BAY, GULF OF CALIFORNIA. FEMALE.—*a*, GNATHOPOD 1; *b*, GNATHOPOD 2; *c*, PERAEOPOD 1; *d*, PERAEOPOD 5

sixth joints missing, second, third, and fourth joints about as in peraeopod 1. Peraeopod 3, second joint with lobe of hind margin rounding and without any downward dip. Peraeopod 4, second

joint not wider above than below, but about the same width throughout, hind margin evenly convex. Peraeopod 5, second joint about

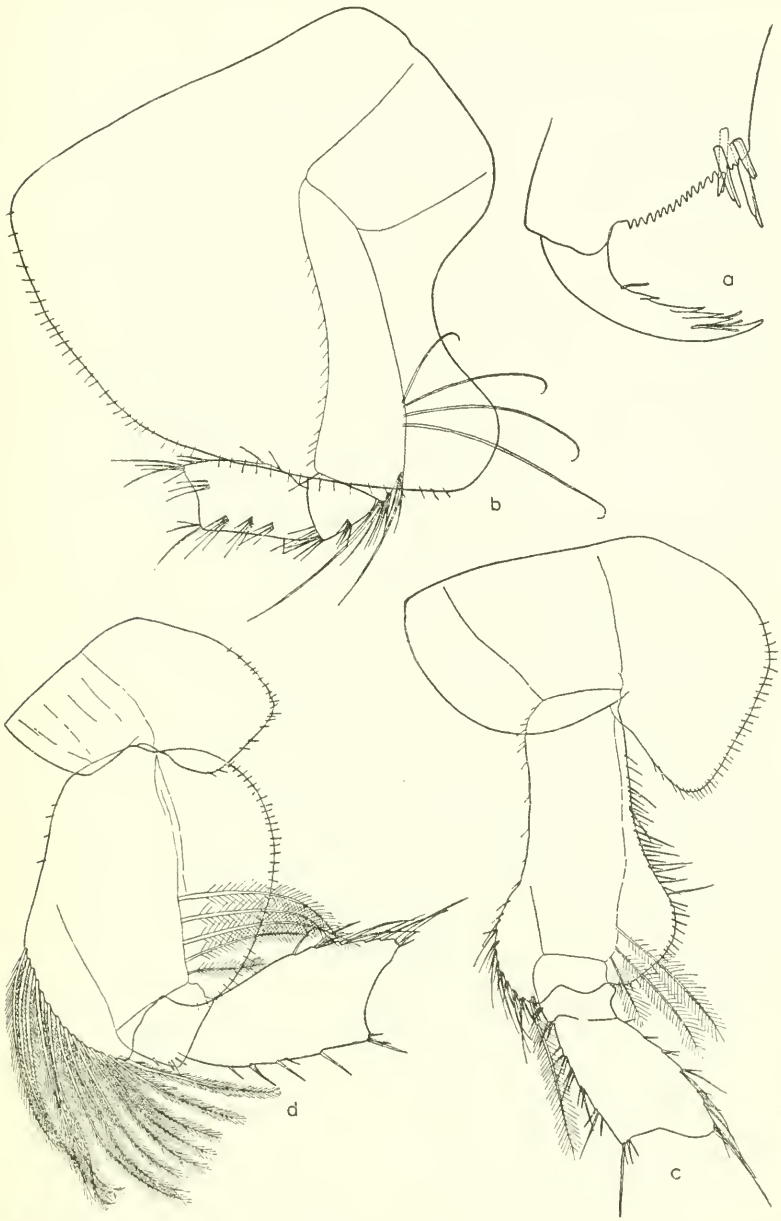

FIG. 6.—BATEA RECTANGULATA SHOEMAKER, SAN FRANCISQUITO BAY, GULF OF CALIFORNIA. FEMALE.—*a*, GNATHOPOD 2, SHOWING TEETH OF PALM AND FINGER; *b*, PERAEOPOD 2; *c*, PERAEOPOD 3; *d*, PERAEPOD 4

as broad as long, lower posterior margin not forming as deep a lobe as in *B. catharinensis*. Side-plates all much deeper than in *B.*

catharinensis. Side-plate 2 rectangular in outline, front and back margins nearly parallel, lower margin transverse, slightly convex and provided with a row of setules. Side-plate 3 extending slightly

FIG. 7.—BATEA RECTANGULATA SHOEMAKER, SAN FRANCISQUITO BAY, GULF OF CALIFORNIA. FEMALE.—*a*, HEAD AND FIRST TWO THORACIC SEGMENTS; *b*, LEFT MANDIBLE; *c*, PALP OF LEFT MANDIBLE; *d*, RIGHT MANDIBLE; *e*, PALP OF RIGHT MANDIBLE; *f*, MAXILLA 1; *g*, MAXILLA 2; *h*, MAXILLIPED; *i*, LOWER LIP

beyond the second joint of the peraeopod, sides nearly parallel but slightly wider below, lower margin transverse, very slightly convex and bordered by a row of minute setules. Side-plate 4 with hind margin not so deeply excavate as in *B. catharinensis*, lower margin unevenly convex and bordered by a row of minute setules. Side-plate 5 with hind lobe deeper and more acute than in *B. catharinensis*. Side-plates 6 and 7 differing very slightly from those of *B. catharinensis*. Posterior lateral margin of abdominal segment 3 bearing a greater number of serrations than that of *B. catharinensis*. Uropods about as in *B. catharinensis*. Telson proportionately shorter and broader than in *B. catharinensis*, lobes with apices acute and inside margins concave, each lobe with two setules near the apex, and each side of telson bearing three setules near the base. Length of the type specimen 6 mm. The only known specimen of this species was obtained by the steamer *Albatross* in 1911 in San Francisquito Bay, Gulf of California, and established the first record of the occurrence of this genus on the west coast of America. The type is in the collection of the United States National Museum, catalogue number 52360.

BATEA TRANSVERSA, new species

(Figures 8–11)

Female.—Head with rostrum evenly-curved downward and very acute, under edge evenly concave. Eyes large, black. Antennae normal. Mandible with third joint of palp a little over half the length of the second, spine arrangement of these two joints as in *B. rectangulata*, five spines in spine-row of left mandible, and four in that of right. Maxilla 1, inner plate with six or seven plumose setae, outer plate armed with stout, curved, toothed spines as in *B. rectangulata*, palp with first joint nearly two-thirds the length of the second. Maxilla 2, inner plate reaching nearly to the end of outer plate, spine and seta arrangement as in *B. rectangulata*. Maxillipeds, inner plate reaching nearly to the end of first joint of palp, armed on its truncated end with three rather blunt spine-teeth, and on the truncated end and inner margin with plumose setae, outer plate reaching nearly to the end of the second joint of palp, armed on its upper rounded end and inner edge with tooth-like spines, second joint of palp a little longer than first or third which are subequal, dactyl evenly curved throughout, point not dipping down as in *B. rectangulata*. Lower lip without inner lobes. Gnathopod 1 normal. Gnathopod 2 proportionally nearly as in *B. rectangulata*, fifth, and sixth joints long and narrow, sixth about four-fifths as long as fifth, widest at distal end, palm nearly transverse, being only slightly oblique, dactyl with three forward-pointing teeth on inner edge. Peraeopods 1 and 2 normal. Peraeopod 3, second joint

with prominent, downward projecting anterior and posterior lobes. Peraeopod 4, second joint proportionately shorter and broader than

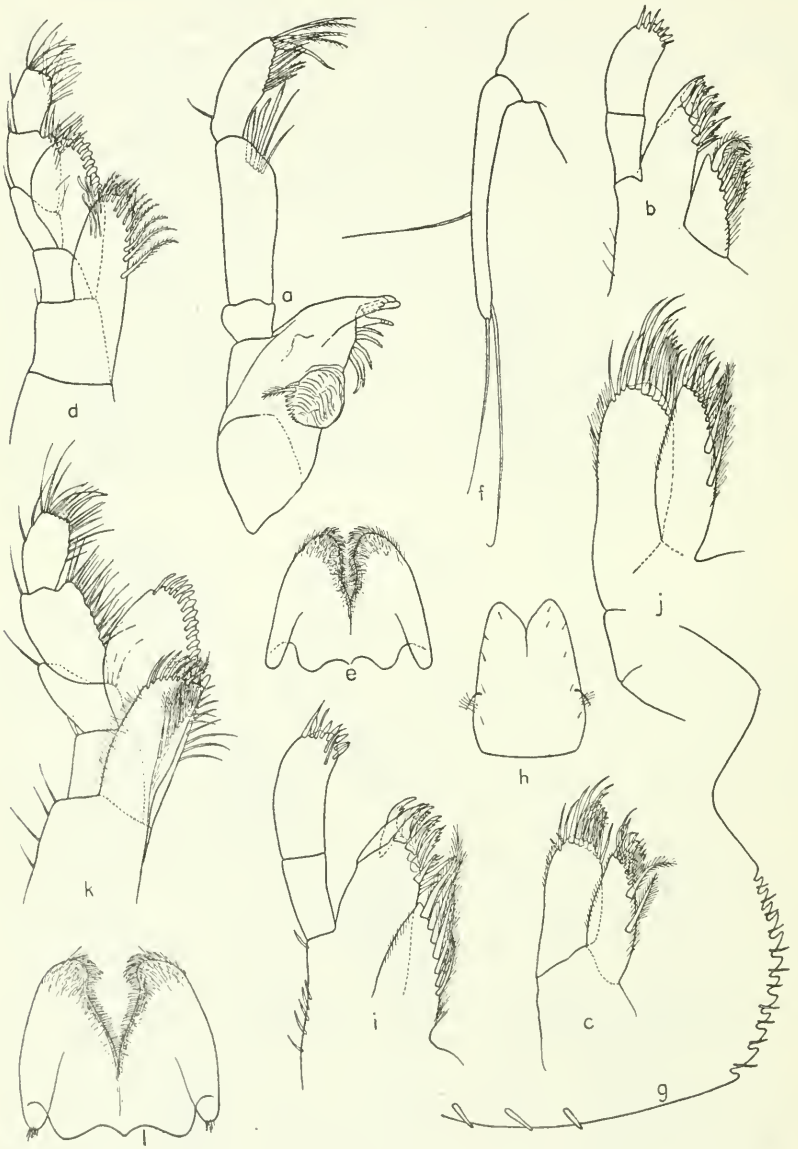

FIG. 8.—BATEA TRANSVERSA, NEW SPECIES, POINT LOMA, CALIFORNIA. MALE.—*a*, MANDIBLE; *b*, MAXILLA 1; *c*, MAXILLA 2; *d*, MAXILLIPED; *e*, LOWER LIP; *f*, GNATHOPOD 1; *g*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3; *h*, TELSON. CATALINA HARBOR, SANTA CATALINA ISLAND, FEMALE.—*i*, MAXILLA 1; *j*, MAXILLA 2; *k*, MAXILLIPED; *l*, LOWER LIP

in *B. rectangulata*, hind margin evenly convex and bearing shallow serrations, lower anterior and posterior lobes both dipping down

about the same distance. Peraeopod 5 much as in *B. rectangulata*, widest through upper part, posterior edge serrate. Side-plates much

FIG. 9.—BATEA TRANSVERSA, NEW SPECIES, CATALINA HARBOR, SANTA CATALINA ISLAND. FEMALE.—*a*, HEAD AND FIRST THREE THORACIC SEGMENTS; *b*, MANDIBLE; *c*, GNATHOPOD 1; *d*, GNATHOPOD 2, MUCH ENLARGED; *e*, PERAEOPOD 1; *f*, PERAEOPOD 3; *g*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3; *h*, TELSON

as in *B. catharinensis*. Abdominal segment 3, posterior lateral margin with teeth shaped and arranged much as in *B. rectangulata*.

Uropods normal. Telson with sides converging and each bearing a row of minute setules, cleft for only about one-third its length, lobes rather bluntly pointed and with inside edges slightly concave.

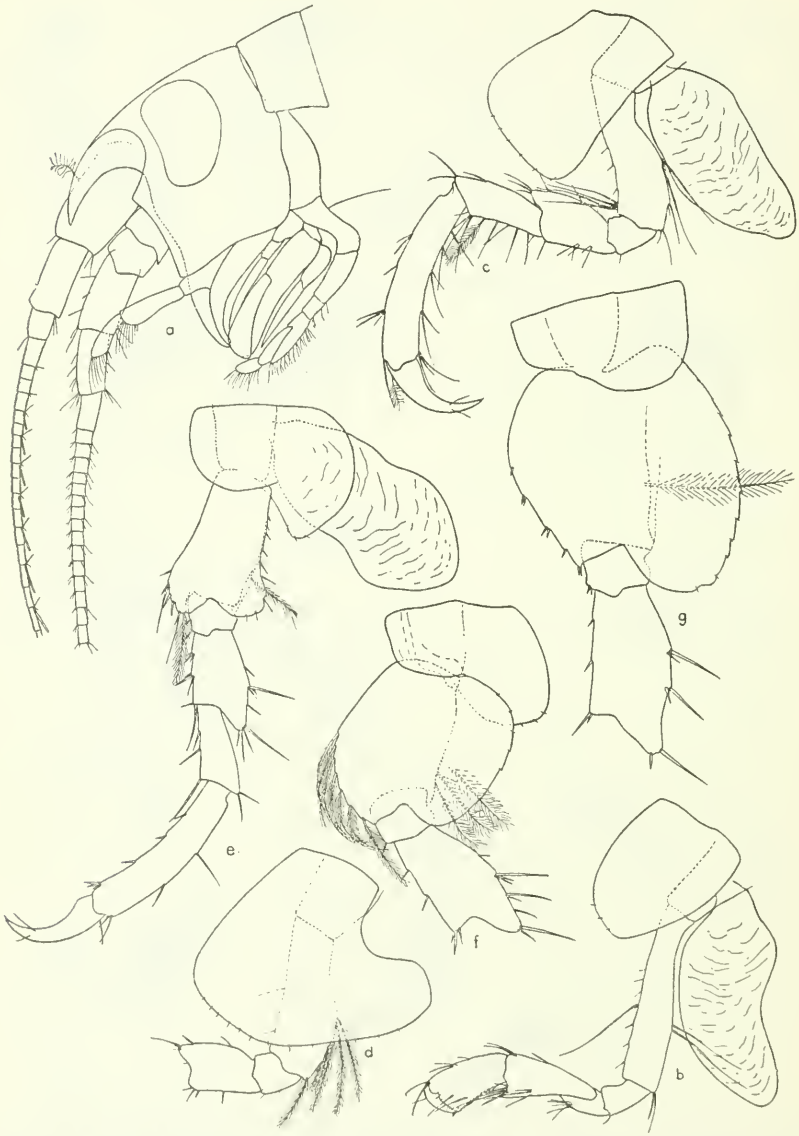

FIG. 10.—BATEA TRANSVERSA, NEW SPECIES, POINT LOMA, CALIFORNIA. MALE.—*a*, HEAD AND ANTENNAE; *b*, GNATHOPOD 2; *c*, PERAEOPOD 1; *d*, PERAEOPOD 2; *e*, PERAEOPOD 3; *f*, PERAEOPOD 4; *g*, PERAEOPOD 5

Length.—5 mm.

Locality.—One-half mile off the wireless station, Point Loma, California, August 20, 1918, collected by Dr. Waldo L. Schmitt.

Type in the United States National Museum, catalogue number 52301.

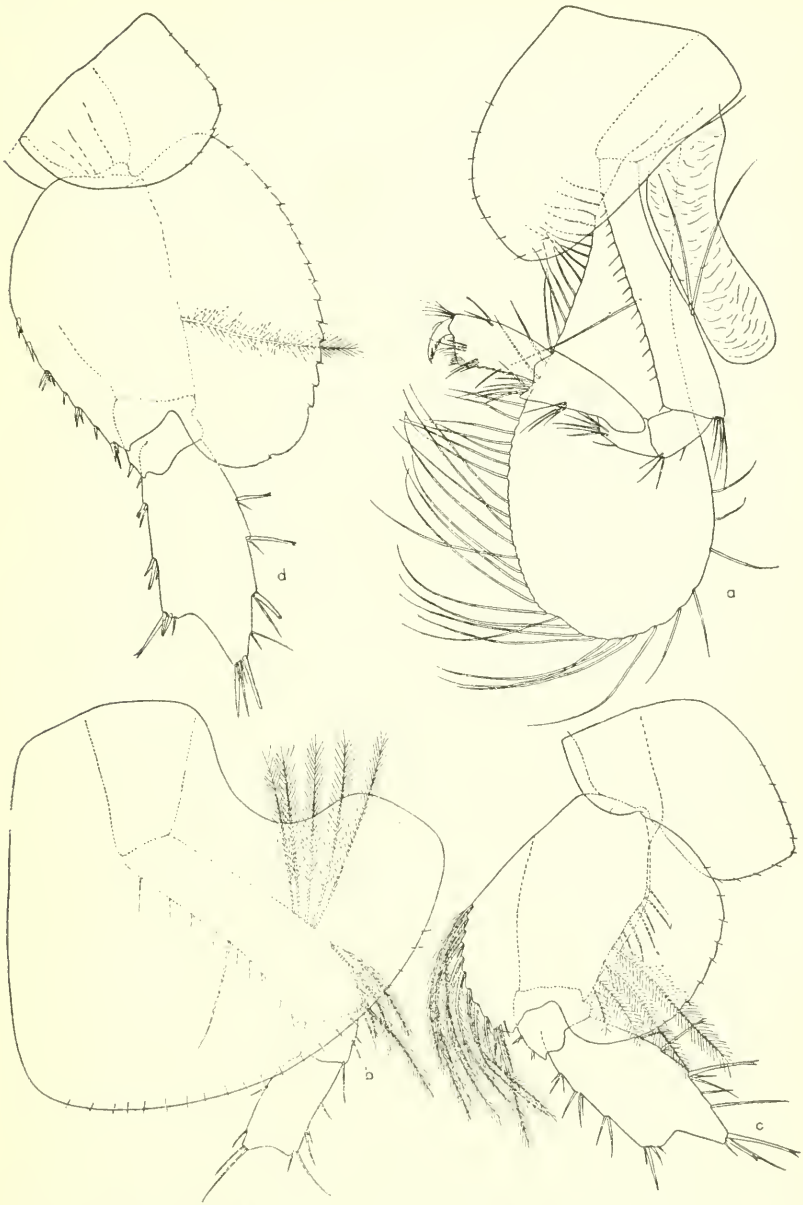

FIG. 11.—BATEA TRANSVERSA, NEW SPECIES, CATALINA HARBOR, SANTA CATALINA ISLAND. FEMALE.—*a*, GNATHOPOD 2; *b*, PERAEOPOD 2; *c*, PERAEOPOD 4; *d*, PERAEOPOD 5

Male.—Antenna 1, alternate joints of flagellum bearing a backward pointing seta and an enlarged sensory seta. Inner plate of maxilla 1 with six plumose setae. Mandibles as in female. Gnath-

opod 1 about as in *B. catharinensis*. Gnathopod 2 as in the female. Peraeopods as in the female. Uropods normal. Telson cleft about one-third of its length, lobes blunter than in female with apices rounding, a plumose setule near the center of outside edges.

The specific name of this species refers to the almost transverse palm of the second gnathopod. Specimens in the collection of the United States National Museum besides the type are as follows: 1 specimen collected at the entrance of Catalina Harbor, Santa Catalina Island, California, by the Venice Marine Biological Station, December 30, 1912; 54 specimens collected off Point Loma, California, by Dr. Waldo L. Schmitt, Aug. 1918.

BATEA LOBATA, new species

(Figures 12, 13)

Female.—Head with rostrum spear-shaped and pointing almost directly forward. Eyes large reniform, black. Lateral angle very flat and rounding. Lower anterior corner rounding. Antennae normal. Mandibles with five spine-teeth in spine-row of left and four in that of right, palp with third joint little shorter than second and armed on the distal front half with many long bristles one of the terminal ones of which is enlarged and dactyl-like, second joint expanded at the distal end and bearing a group of long bristles on this expansion, no bristles on the proximal part of the joint. Maxilla 1 with nine plumose setae on inner plate, outer plate and palp as in *B. rectangulata*. Maxilla 2 as in *B. rectangulata*. Maxillipeds, inner plate extending a little beyond the end of the first joint of the palp and bearing three spine-teeth on its truncated end, outer plate not reaching the end of the second joint of the palp, inner edge armed with a row of tooth-like spines, no plumose setae on end of plate, first joint of palp about two-thirds as long as second, second a little longer than third. Lower lip without inner lobes. Gnathopods 1 and 2 much as in *B. catharinensis*. Gnathopod 2, fifth, and sixth joints subequal in length and width, fifth joint longer than wide with the lobe of hind margin much less acute than in *B. catharinensis*, sixth joint with palm oblique, slightly convex and a little shorter than hind margin of joint, dactyl with four or five teeth on inner edge. Peraeopods much as in *B. catharinensis*. Second joint of peraeopod 3 with the lower posterior lobe a little more prominent and crenulate than in *B. catharinensis*. Second joint of peraeopod 4 not noticeably wider above than below, with hind margin evenly convex. Second joint of peraeopod 5 as broad as long, widest through upper third. Side-plate 2 as in *B. catharinensis*. Side-plate 3 with sides less divergent than in *B. catharinensis*. Side-plate 4 as in *B. catharinensis*. Side-plate 5 with hind lobe a little

more acute below than in *B. catharinensis*. Side-plates 6 and 7 as in *B. catharinensis*. Abdominal segment 3 with serrations of lateral margin very obscure, the lower ones are very flat with very minute upturned points while the upper ones are reduced to mere flattened

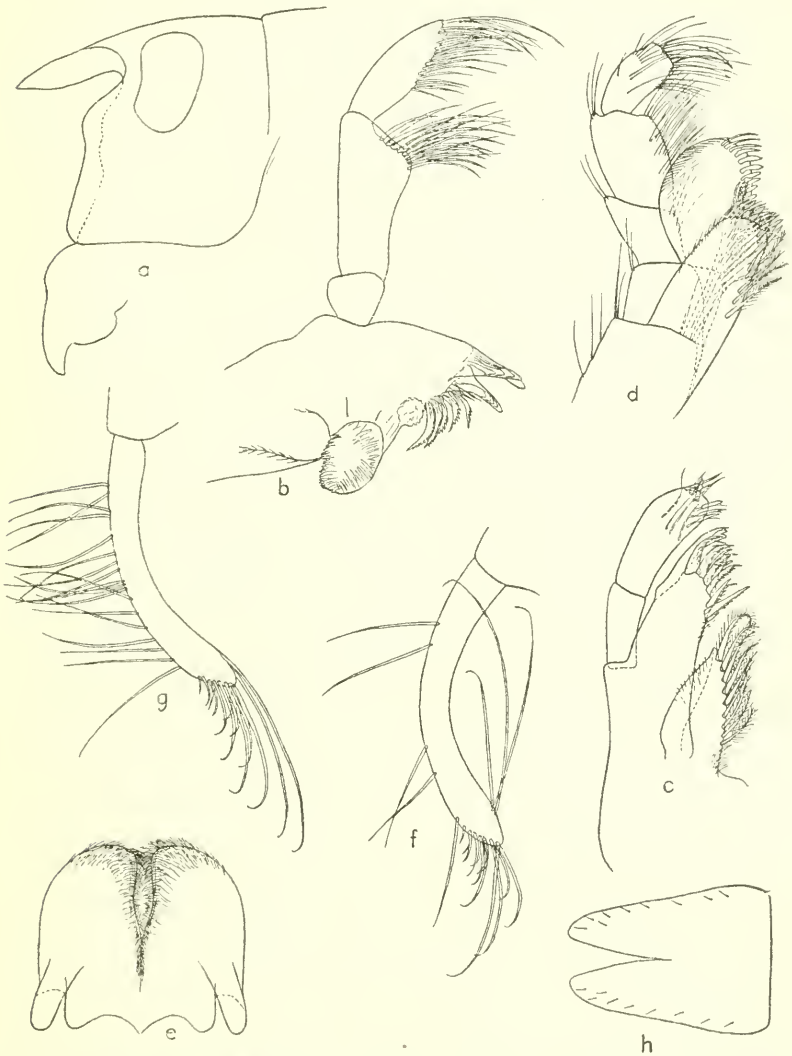

FIG. 12.—BATEA LOBATA, NEW SPECIES. FEMALE.—*a*, HEAD; *b*, MANDIBLE; *c*, MAXILLA 1; *d*, MAXILLIPED; *e*, LOWER LIP; *f* AND *g*, GNATHOPOD 1; *h*, TELSON

lobes. Uropods normal. Telson with outer edges furnished with a row of spinules, and lobes more acute than in *Batea catharinensis*.

Length.—6 mm.

Locality.—From end of pier at La Jolla, Southern California, collected by Percy S. Barnhart of the Scripps Institution, November 25, 1915.

Type.—United States National Museum catalogue number 52309. The specific name of this species refers to the very flat lobes which

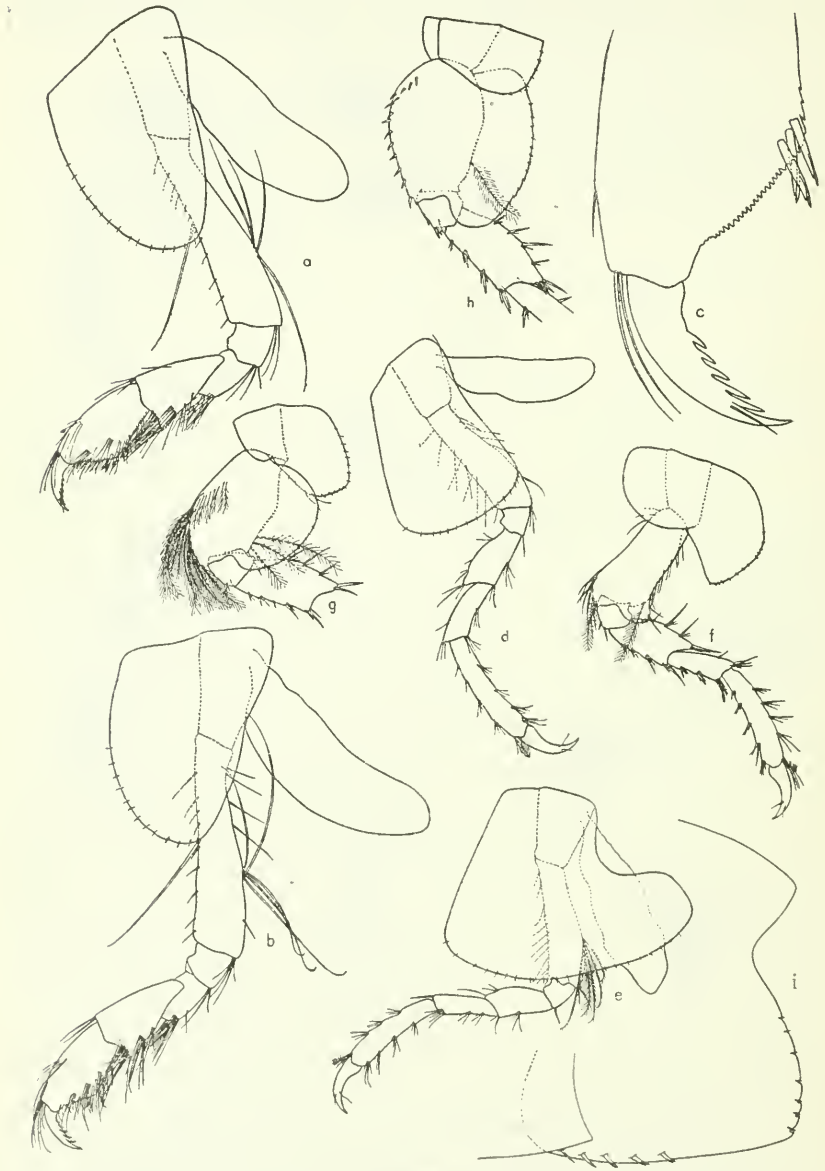

FIG. 13.—BATEA LOBATA, NEW SPECIES. FEMALE.—*a* AND *b*, GNATHOPOD 2; *c*, GNATHOPOD 2, MUCH ENLARGED; *d*, PERAEOPOD 1; *e*, PERAEOPOD 2; *f*, PERAEOPOD 3; *g*, PERAEOPOD 4; *h*, PERAEOPOD 5; *i*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3

take the place of the teeth on the posterior lateral edge of the third abdominal segment in the other known species of this genus. Besides the type there are in the collection of the United States

National Museum 13 specimens from La Jolla, southern California, collected by the Scripps Institution.

CARINOBATEA, new genus

Last thoracic and first and second abdominal segments strongly dentate. Lower lip without inner lobes. Outer plates of maxillipeds reaching to or a little beyond the end of second joint of palp. Otherwise as in *Batea*.

Genotype.—*Carinobatea cuspidata*, new species.

CARINOBATEA CUSPIDATA, new species

(Figures 14, 15)

Male.—Head, rostrum downward-curved, lance-shaped and sharply pointed, lateral angle shallow and blunt, lower front margin slightly concave, lower anterior angle rather sharp, eyes large and light yellow. Antenna 1 about three-fourths as long as body, first joint of peduncle with lower margin produced forward into a long sharp point extending beyond the middle of the second joint, second joint much smaller than first, third joint less than half the length of second, both first and second joints bearing tufts of setae on their lower margins, flagellum composed of many short joints which bear forward-pointing setae at their lower distal edges, no backward-pointing setae as in *B. catharinensis*. Antenna 2 as long as the entire body, fourth and fifth joints with tufts of setae on their upper margins, flagellum composed of many short joints which bear forward-pointing setae at their upper distal edges. Mandibles, four spine-teeth on right and five on left, palp with second joint slightly curved and bearing a few long bristles on the front distal edge, third joint a little over half the length of the second and bearing a row of fine bristles on the front edge and a stout dactyl-like spine at the distal end, the hind margin of third joint bearing a group of long curved bristles near the proximal end. Maxilla 1, outer plate with a row of 11 toothed spines, inner plate with eight plumose setae, palp with second joint very little longer than first, a row of short spines on distal end. Maxilla 2 as in *Batea catharinensis*. Maxilliped, outer plate reaching just to the end of the second joint of palp and bearing eight odontoid spines on inner edge, inner plate with three stout spine-teeth on truncated end. Lower lip without inner lobes or at best a mere suggestion of them. Gnathopod 1 very slender and recurved, widening a little toward the distal end, front margin bearing six slender setae, hind margin bearing five long curved setae arranged in a compact row near the distal end, two slender setae on distal extremity. Gnathopod 2, front and lower margins of side-plate evenly

curved, second joint shorter than side-plate, third joint at least two-thirds the length of second, fifth joint slender and about equal in length to third, lower distal edge produced into an acute angle, sixth joint shorter than fifth, palm not very oblique, shorter than hind

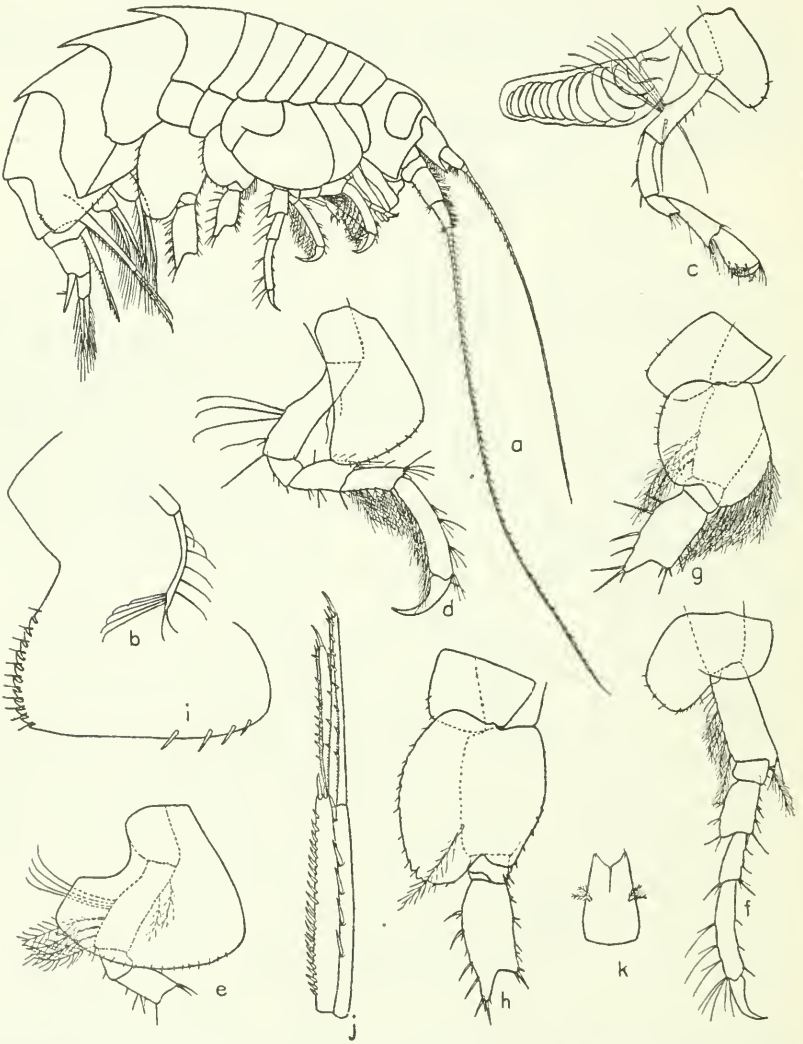

FIG. 14.—CARINOBATEA CUSPIDATA, NEW GENUS AND SPECIES. MALE.—*a*, ENTIRE ANIMAL; *b*, GNATHOPOD 1; *c*, GNATHOPOD 2; *d*, PERAEOPOD 1; *e*, PERAEOPOD 2; *f*, PERAEOPOD 3; *g*, PERAEOPOD 4; *h*, PERAEOPOD 5; *i*, POSTERIOR LATERAL MARGIN OF ABDOMINAL SEGMENT 3; *j*, UROPOD 1; *k*, TELSON

margin and minutely toothed throughout, several stout spines defining the palm. Dactyl equaling palm in length, curved, and bearing four teeth on inner margin. Peraeopod 1, side-plate with front margin slightly convex, lower margin slightly convex, hind margin

concave, and lower posterior corner evenly rounded, limb as in *Batea catharinensis*. Peraeopod 2, side-plate with hind lobe not so much produced as in *B. catharinensis*, lower margin evenly convex, second

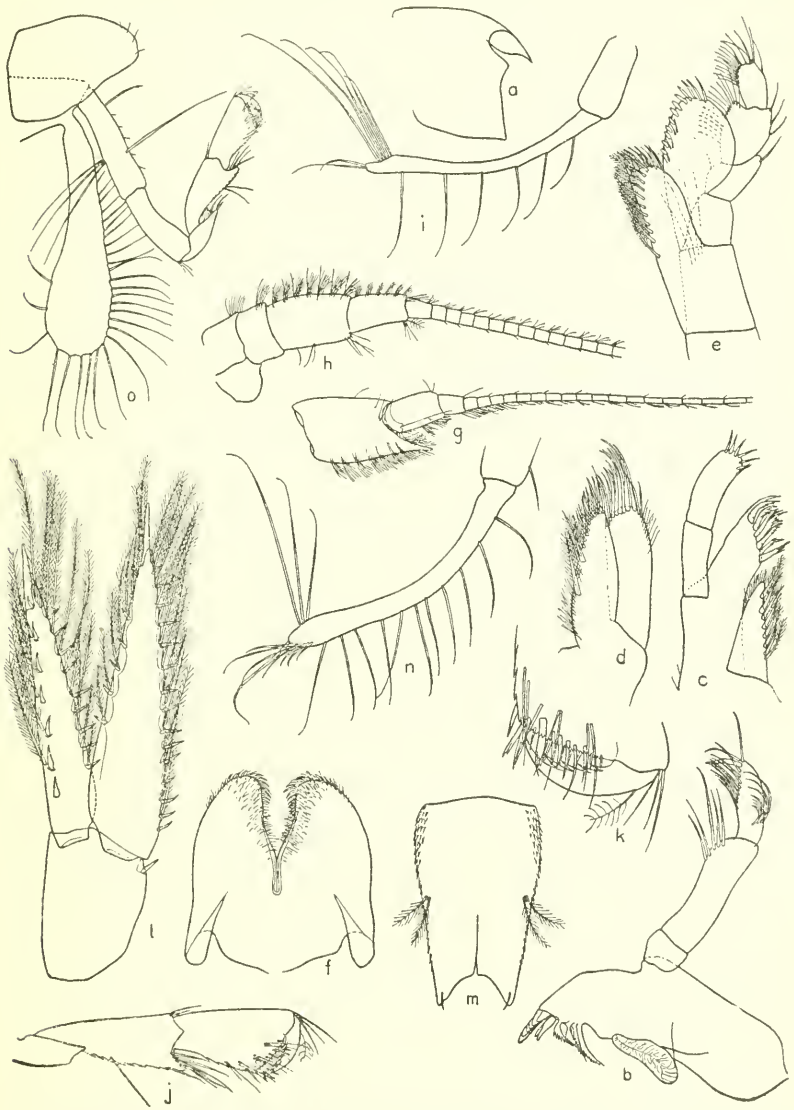

FIG. 15.—CARINOBATEA CUSPIDATA, NEW GENUS AND SPECIES. MALE.—*a*, HEAD; *b*, RIGHT MANDIBLE; *c*, MAXILLA 1; *d*, MAXILLA 2; *e*, MAXILLIPED; *f*, LOWER LIP; *g*, ANTENNA 1; *h*, ANTENNA 2; *i*, GNATHOPOD 1; *j*, GNATHOPOD 2; *k*, GNATHOPOD 2, ENLARGED; *l*, UROPOD 3; *m*, TELSON. FEMALE.—*n*, GNATHOPOD 1; *o*, GNATHOPOD 2

joint bearing four long plumose setae near lower hind margin and four long simple setae near middle, rest of limb normal. Peraeopod 3, side-plate differing little from that of *B. catharinensis*, second

joint not expanded below as in *B. catharinensis*, hind margin straight and bearing a row of plumose setae, no lobe at lower hind corner, rest of limb normal. Peraeopod 4, side-plate as in *B. catharinensis*, second joint widest through the lower part, hind margin evenly convex, rest of limb normal. Peraeopod 5, nearly as in *B. catharinensis*, but second joint proportionately a little shorter. The seventh thoracic and the first two abdominal segments are produced dorsally into prominent, sharp, backward-pointing processes. The lower lateral margin of the third abdominal segment with 11 upward-pointing teeth at the base of each of which is a setule. Uropod 1, outer edge of peduncle provided with a row of short, closely-set spines. Uropod 3, outer ramus slightly shorter than inner, both rami provided on their edges with a row of short spines and long plumose setae, each ramus ending in a long, slender, transparent point, at the base of which is a prominent lobe. Telson with sides convex at base then straight and converging, each side bearing two plumose setae at center, cleft not reaching middle, lobes with inside margins concave, apices pointed and each bearing a setule near the end.

Length.—5 mm.

Locality.—Between Water Island and Saint Thomas, Virgin Islands of the United States, June 28, 1915, 2–5 fathoms, collected by Clarence R. Shoemaker.

Type.—United States National Museum, catalogue number 52295.

Female.—Very much like the male but not quite so slender. Rostrum narrower and sharper than in male. Gnathopod 1 a little stouter than in male. Gnathopod 2 as in male but with the second joint longer than side-plate, and third joint three-fourths the length of second.

There are in the collection of the United States National Museum the following specimens: 7 specimens collected in shallow water about the Island of Saint Thomas, Virgin Islands of the United States, by Clarence R. Shoemaker during the summer of 1915; 1 specimen collected off the west coast of Florida by the steamer *Albatross*, between station numbers 2369–74, February 7, 1885, depth 64 fathoms; 1 specimen probably collected at Porto Rico, collector and date unknown.

CARINOBATEA CARINATA, new species

(Figure 16)

This species closely resembles *Carinobatea cuspidata* but differs in the following characters. Rostrum a little longer, narrower, and more acutely pointed than in *C. cuspidata*. Gnathopod 2, second joint as long as or a little longer than side-plate, third joint less than one-third the length of second, fifth and sixth proportionately

shorter and broader than in *C. cuspidata*, palm a little more oblique and more coarsely toothed. Peraeopod 5, second joint much wider above than below with hind margin nearly straight and coarsely serrated. The last thoracic and the first two abdominal segments produced backward dorsally into sharp points, and these segments

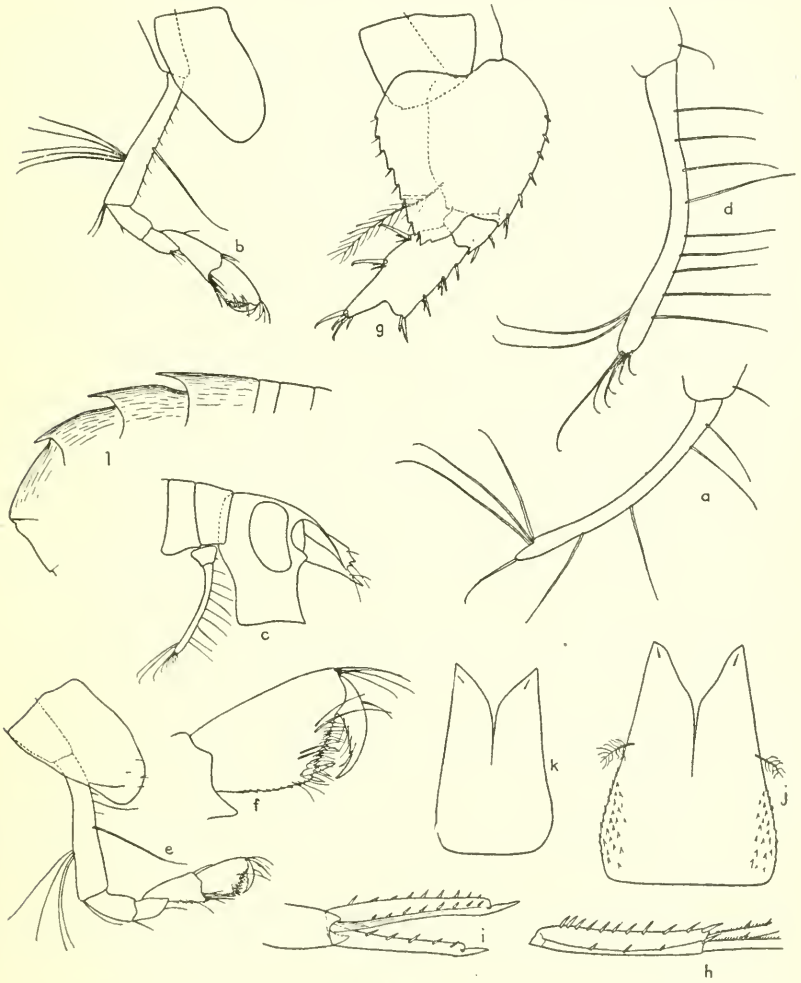

FIG. 16.—CARINOBATEA CARINATA, NEW GENUS AND SPECIES. MALE.—*a*, GNATHOPOD 1; *b*, GNATHOPOD 2. FEMALE.—*c*, HEAD AND GNATHOPOD 1; *d*, GNATHOPOD 1; *e*, GNATHOPOD 2; *f*, HAND, ENLARGED; *g*, PERAEOPOD 5; *h*, UROPOD 1; *i*, UROPOD 3; *j*, TELSON; *k*, TELSON OF ANOTHER INDIVIDUAL; *l*, ABDOMEN, SHOWING CARINAE

compressed dorsally forming slight but distinct carinae. Uropod 1 with less than half as many spines on outer edge of peduncle as in *C. cuspidata*. Uropod 3 not so broad and flat as in *C. cuspidata*, but with similar points and lobes at the ends of the rami. These rami are probably furnished with long plumose setae as in *C. cuspi-*

data, but the specimens having been in alcohol since 1885, these setae have all become detached except in a couple of specimens where there are one or two still remaining near the extremity of the rami. Telson cleft a little beyond the middle, lobes acute with inside edges either slightly concave or slightly convex.

Length.—Female, 5 mm.

Locality.—Albatross station 2405, off the west coast of Florida, 28° 45′ 00″ N., 85° 02′ 00″ W., March 15, 1885, depth 30 fathoms.

Type.—United States National Museum, catalogue number 52315.

There are in the collection of the United States National Museum besides the type, the following specimens: 1 specimen, *Albatross* station 2369–74, off west coast of Florida, February 7, 1885, depth 26 fathoms; 39 specimens, *Albatross* station 2405, off the west coast of Florida, 28° 45′ 00″ N., 85° 02′ 00″ W., March 15, 1885, depth 30 fathoms; 1 specimen *Albatross* station 2409 off west coast of Florida, 27° 04′ 00″ N., 83° 21′ 15″ W., March 18, 1885, depth 26 fathoms.

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